~~Mr. Jno. Duncan~~

THE OUTLOOK FOR NAVAL STORES

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THE OUTLOOK FOR NAVAL STORES

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The Forest Service drew upon its extensive forest survey data and conducted special production surveys, made appraisals of factors affecting future naval stores supplies, evaluated needs and opportunities for future research, and coordinated cooperative work of contributors to the various phases of the project.

The Agricultural Stabilization and Conservation Service contributed sections regarding the gum naval stores price-support program, production capacity of naval stores plants, and analyses of trends in naval stores prices, foreign production and consumption, and related export demand for U.S. supplies.

The Agricultural Research Service prepared sections of the report relating to current and potential domestic markets and demands for naval stores products, and cooperated with the Forest Service in summarizing opportunities for future utilization research.

The Statistical Reporting Service compiled the historical data included on domestic production and consumption of naval stores.

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Space does not permit mention of the many individuals who participated in the study. Special acknowledgment is made, however, to major contributions of helpful information and technical advice by H. R. Josephson, A. S. Todd, Dwight Hair, T. A. Harrington, R. W. Clements, N. R. Hawley, M. E. Metcalf, and C. H. Overboy of the Forest Service; Milton S. Briggs and Kathryn Wygal of the Agricultural Stabilization and Conservation Service; Emil Ott, Agricultural Research Service consultant; and J. J. Morgan of the Statistical Reporting Service.

PREFACE

The purpose of this report is to bring together basic facts and results of appraisals of important demand and supply factors affecting the outlook for naval stores. It is hoped these findings will provide guides for future development of the industry, for integrating naval stores production with other forest management programs, and for future programs of research in naval stores production and utilization in the United States.

The study was prompted by substantial increases in demands for and prices of rosin during 1959 and 1960, and growing interest and concern regarding the future of the industry among gum and steam-distilled wood naval stores producers, consumers of naval stores products, and among Government officials with responsibilities in this field.

Naval stores are derived from the distillation or related processing of the oleoresins of softwood trees. Rosin and turpentine are the major products, and several others such as pine oil and dipentene are produced in smaller quantities.

The United States has been the world's largest producer and exporter of naval stores for more than a century. Although production of naval stores represents only a small segment of this Nation's industrial complex, the industry is of significant importance in the naval stores region from the Carolinas to Texas, and especially in Georgia and northern Florida. Output of primary naval stores products during the 1960 crop year, f.o.b. plant, was valued at about $165 million. Rosin accounted for 87 percent of this total value, turpentine for 6 percent, and all other products combined for the remaining 7 percent. The harvesting and processing of naval stores provided some 13,000 man-years of employment in 1960 for more than 20,000 workers. Thus the outlook for naval stores is of appreciable concern to many individuals, companies, and communities in producing areas as well as to consumers throughout the industrial world.

The report first presents a brief description of the U.S. naval stores industry. Next, past trends in domestic production are described, followed by appraisals of factors affecting U.S. production capabilities in the future and of the production potential of the U.S. naval stores industry. Consumption trends in the United States and potential demands for future domestic uses are then considered. Foreign production and consumption, the U.S. position in world markets, and future export demands for U.S. supplies are next appraised. Price trends and relationships are discussed. The outlook for demand and for supply of U.S. naval stores are then indicated by combining all above factors. Finally, the importance of and opportunities for future naval stores research are briefly appraised.

CONTENTS

SUMMARY AND CONCLUSIONS

The major findings and conclusions of this analysis may be summarized as follows:

There are three major divisions of the U.S. naval stores industry: gum, steam-distilled wood, and sulfate—

Gum naval stores are produced from crude gum (oleoresin) from living longleaf and slash pine trees. This source accounted for 23 percent of all rosin and 24 percent of all turpentine produced in the United States during the 1961 crop year.

Steam-distilled wood naval stores are produced from resin-saturated stumps of the original old-growth longleaf and slash pine forests of the Southeast. This source accounted for 54 percent of all rosin and 24 percent of all turpentine produced in the United States during 1961.

Sulfate naval stores are produced from formerly wasted byproducts of paper production by the sulfate process. Tall oil rosin from this source and sulfate turpentine accounted for 23 percent of all rosin and 52 percent of all turpentine domestically produced in 1961.

Since the early 1900's, there has been little change in the volume of rosin and turpentine produced in the United States, but big changes in source—

Domestic production in 1960 was 2 million drums of rosin and 605,000 barrels of turpentine, somewhat more than the average annual production since 1900 of 1.7 million drums and 600,000 barrels.

In the early 1900's all U.S. naval stores were produced from gum. Since about 1930 an appreciable decline in production from gum has been offset by increased production from steam-distilled wood and, more recently, from sulfate sources.

The potential naval stores production capability of the United States is at least 2½ times the volume produced in 1960—

U.S. capability to produce gum naval stores is at least 7 times 1960 output.

Steam-distilled wood production potential depends on the life of the stumpwood resource which can sustain 1960 output until 1986 or two-thirds to one-half of this output until the end of the century.

Sulfate naval stores production capability by 1970 is expected to be 75 percent greater than 1960 output.

Markets rather than supply factors are likely to determine U.S. production levels in the future.

Demands for U.S. rosin are expected to total 2,146,000 drums in 1970, 5 percent more than in 1960—

Consumption of rosin by U.S. industries is likely to reach 1,606,000 drums annually by 1970 compared to 1,408,800 drums in 1960, an increase of 14 percent.

Export markets for U.S. rosin in 1970 are expected to total 540,000 drums. This would roughly equal average annual U.S. rosin exports since 1946 and would comprise about 25 percent of the total 1970 market for U.S. rosin.

Demands for U.S. turpentine in 1970 are expected to total 707,000 barrels, 17 percent more than in 1960—

Turpentine requirements for domestic uses were projected to 592,000 barrels annually by 1970 compared to 523,000 barrels in 1960, an increase of 13 percent.

Foreign requirements for U.S. turpentine are expected to total 115,000 barrels in 1970. This would exceed the volume of U.S. turpentine exported in 1960 by 41 percent and would comprise about 15 percent of the total 1970 market for U.S. turpentine.

Foreign naval stores production and consumption are expected to increase at faster rates than those of the United States during the 1960's—

Foreign rosin production is projected to 3,060,000 drums in 1970, nearly 40 percent more than 1961 foreign output.

Foreign rosin consumption may rise to 3.6 million drums in 1970, an increase of 38 percent or nearly 1 million drums more than 1961 foreign consumption.

Foreign turpentine production is expected to increase about one-third to 1,135,000 barrels in 1970.

Foreign turpentine consumption may reach 1,250,000 barrels in 1970, nearly one-third million barrels or 35 percent more than in 1961.

Exports continue to provide important outlets for United States naval stores—

U.S. rosin, turpentine, and tall oil exported in 1961 were valued at about $40 million.

Prior to World War II (1934–38), exports provided nearly half of the total market for U.S. rosin, compared to 30 percent during the period 1957–61.

U.S. turpentine exports remain significant although considerably below prewar levels; 38 percent of total U.S. disappearance during 1934–38 compared to 12 percent during 1957–61.

Less than 1 percent of U.S. crude tall oil output was exported in 1961, and combined exports of crude and refined tall oil aggregated less than 5 percent of U.S. output. However, about 16 percent of U.S. tall oil rosin output and 15 percent of U.S. production of tall oil fatty acids in 1961 were exported.

United States now produces about half of the world's naval stores, but is not keeping up with increases in foreign production—

United States produced two-thirds of world rosin output during the 1946–50 period and its share declined to 48 percent in 1961. Despite some increase in U.S. production, the U.S. share of world rosin production probably will continue downward to about 41 percent in 1970.

During the same period, between 1946–50 and 1961, the U.S. share of world turpentine production declined from 60 to 43 percent, where it will likely remain through this decade.

The United States now produces, and probably will continue to produce, about three-fourths of the world's output of crude tall oil, exclusive of the Sino-Soviet bloc.

Outlook for U.S. rosin production in 1970: small increase in volume, big change in source—

To meet prospective requirements in 1970, U.S. rosin production must increase from 2,009,960 drums in 1960 to 2,146,000 drums in 1970, an increase of 6 percent.

Steam-distilled wood rosin production is likely to decline 34 percent to about 800,000 drums between 1960 and 1970.

Tall oil rosin production in the United States is projected upward to 730,000 drums in 1970, 75 percent more than 1960 output.

Gum rosin production, to fill the gap, must then increase to 616,000 drums in 1970, an increase of 65 percent over 1960 output.

Outlook for U.S. turpentine production in 1970 is about 866,000 barrels, 43 percent more than 1960 output—

A 43-percent increase in turpentine production would accompany the prospective 6-percent increase in rosin production. This would result from the anticipated partial shift in sources of rosin from steam-distilled wood to more gum and tall oil rosin which yield substantially more turpentine per unit of rosin produced.

Production of 866,000 barrels would exceed projected turpentine demand of 707,000 barrels by about 160,000 barrels, indicating ample turpentine supplies for possible new or expanded uses beyond those visualized in this analysis.

Research has been essential in development of the naval stores industry—

Many products such as hydrogenated rosin, polymerized rosin, zinc resonates, rosin dimers, terpene hydroperoxides, and synthetic pine oils are the results of intensive naval stores utilization research.

Much research on production methods and techniques was required in developing the isolation and purification schemes used in extracting and processing steam-distilled wood and sulfate naval stores.

The continued existence of the gum naval stores industry today is attributed by many to reduced gum production costs and increased yields made possible by past research.

Many opportunities exist for beneficial future research to develop additional uses, to improve efficiency of production and processing methods that will help provide dependable supplies of naval stores at stabilized lower prices and, most important, to thus make possible greater contributions to the national economy from this versatile source of useful chemical products.

THE NAVAL STORES INDUSTRY IN THE UNITED STATES

The naval stores industry in the United States is based primarily on two species of southern pine, longleaf pine (*Pinus palustris*, Mill.) and slash pine (*Pinus elliottii*, Engelm.). The natural range of these species extends from the Carolinas southward through Florida and westward along the Coastal Plain to Texas (fig. 1). There are three major divisions of the naval stores industry: gum, steam distilled wood, and sulfate.

Gum Naval Stores Are Produced From Oleoresin of Living Pine Trees

The gum naval stores industry, the old traditional source of naval stores, uses as a raw material crude gum (oleoresin) from living longleaf and slash pine trees. Gum is obtained by chipping or streaking the bark of living pine trees at intervals of from 1 to 2 weeks (fig. 2). The streak is sprayed with sulfuric acid to stimulate and prolong the flow of gum. Gum produced as a result of such chipping is channeled by metal gutters into cups attached to the tree. The crude gum is then "dipped" or scraped from the cups and hauled to central plants where it is processed into rosin and turpentine. Gum harvesting requires much labor and accounts for most employment in the naval stores industry.

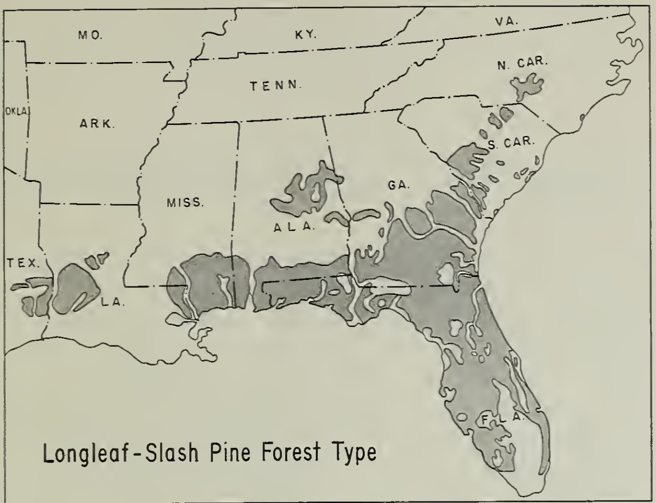

FIGURE 1.—The naval stores industry is located mainly in the longleaf-slash pine forest type of the Southeast.

About 4,000 gum producers worked nearly 30 million faces during the 1960 crop year (table 1).[1] Production was increased in 1961 with 5,126 producers and about 38 million faces. The smaller producers work independently with no hired help. The larger producers employ thousands of woods laborers—about 3 laborers for each "crop" of 10,000 faces. As shown in figure 3, about 85 percent of all producers in 1960 worked less than 10,000 faces each. These small operators accounted for about one-third of all gum produced. Two-thirds of the 1960 gum crop was harvested by about 580 producers who worked more than 10,000 faces each. Almost one-third of the total crop was harvested by some 120 producers with 50,000 or more faces each.

Georgia leads the Nation in gum production (fig. 4). The 3,500 producers in Georgia worked more than 24 million faces during 1960 and harvested more than 500,000 barrels of gum—82 percent of the national gum crop (table 2). Florida ranked second in gum production, with about 200 producers and 11 percent of the total gum crop. The remaining 7 percent of gum output was by some 200 producers in Alabama, Mississippi, Louisiana, and South Carolina, in that order of importance.

The crude gum is hauled to central processing plants (fig. 5). Here it is melted, diluted with turpentine, filtered, sprayed into water, and settled to remove bark, chips, and other foreign matter. The cleaned gum is then processed into gum rosin and gum turpentine by steam distillation. Twenty gum-processing plants operated in 1961; 14 in Georgia, 2 each in Alabama and Florida, and 1 each in Mississippi and Louisiana (fig. 6 and table 3). All 20 plants use the "Olustee Process"

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FIGURE 2.—Crude gum is obtained by chipping or streaking the bark from living longleaf and slash pines, and collecting the flow of gum in cups attached to the trees.

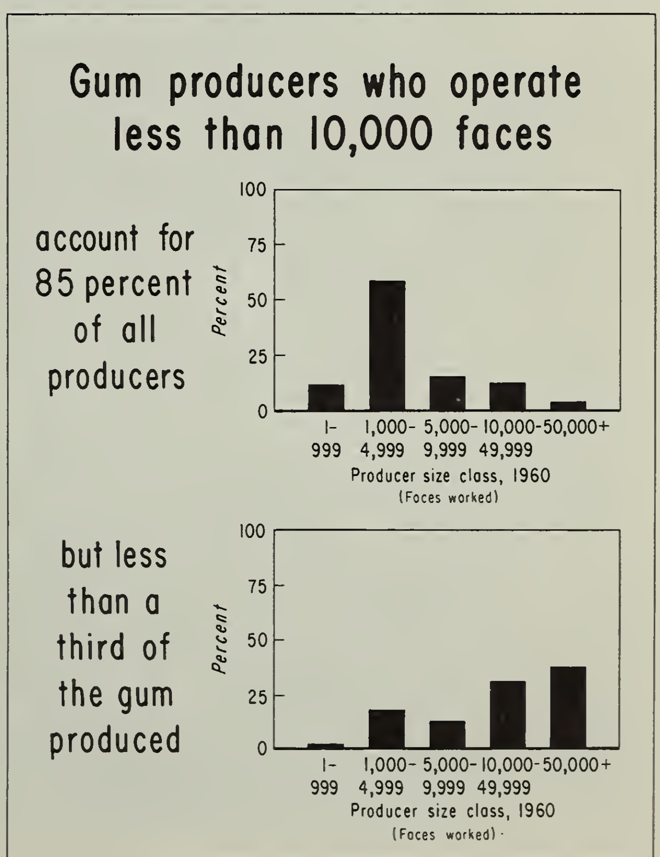

FIGURE 3

[1] All tables are in the appendix starting on page 61.

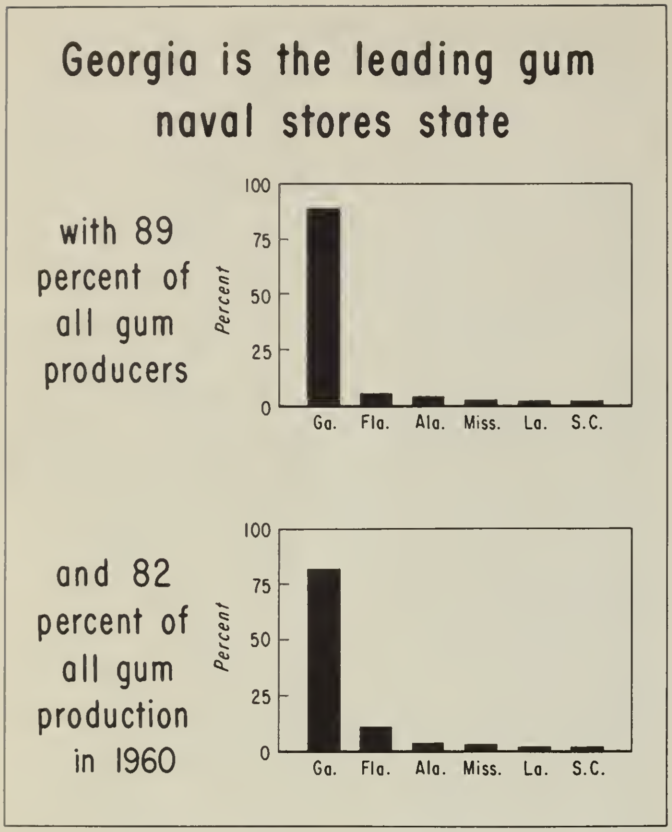

FIGURE 4

developed by the U.S. Department of Agriculture, and were licensed by the Secretary of Agriculture to operate under U.S. Patent 2,254,785.

Steam Distilled Wood Naval Stores Are Produced From Old-Growth Pine Stumps

The steam distilled wood naval stores industry uses as raw material resin-saturated stumps of the original old-growth longleaf and slash pine forests. Small quantities of resinous logs are sometimes included. In 1960 about 2.4 million tons of stumpwood were received at the steam distillation plants (table 4). About half of this volume was harvested in Florida and most of the remainder came from Mississippi, Alabama, Louisiana, and Georgia, in that order of importance (fig. 7). Small amounts, totaling less than 80,000 tons, were harvested in Texas and South Carolina. About 2.1 million tons of stumpwood were processed in 1960; the additional 0.3 million tons shipped from the forests were added to reserve stump inventories at the plants. With a 9-percent reduction in steam-distilled wood rosin production in 1961, consumption of stumpwood declined to about 1.9 million tons.

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FIGURE 5.—A modern gum-processing plant where crude gum is processed into rosin and turpentine by steam distillation.

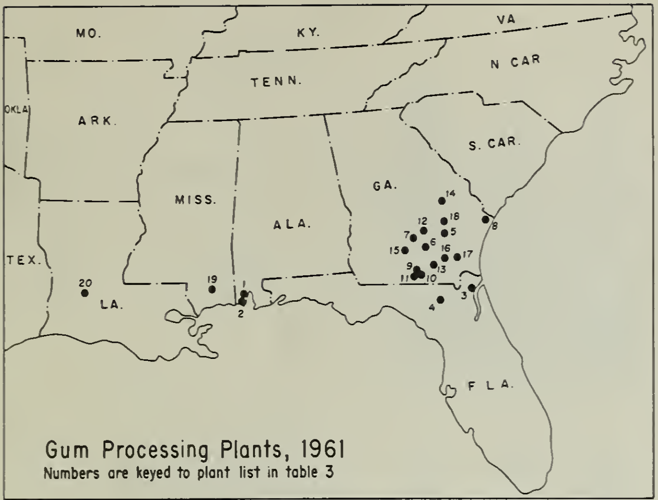

FIGURE 6

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FIGURE 8.—Harvesting naval stores stumps is a highly mechanized operation.

Harvesting stumps is a highly mechanized operation, in contrast to the hand labor used by the gum industry (fig. 8). The stumps are pushed from the ground by bulldozers, loaded on trucks generally by mechanical loaders, and hauled to rail shipping points or directly to plants. At the plant this waste wood is chipped, shredded, and subjected to solvent extraction. The extract is then steam distilled to obtain wood rosin, wood turpentine, and other minor naval stores products. Twelve of these plants operated in 1961 at locations shown in figure 9 and table 5. One additional plant was under construction at Wilmington, N.C.

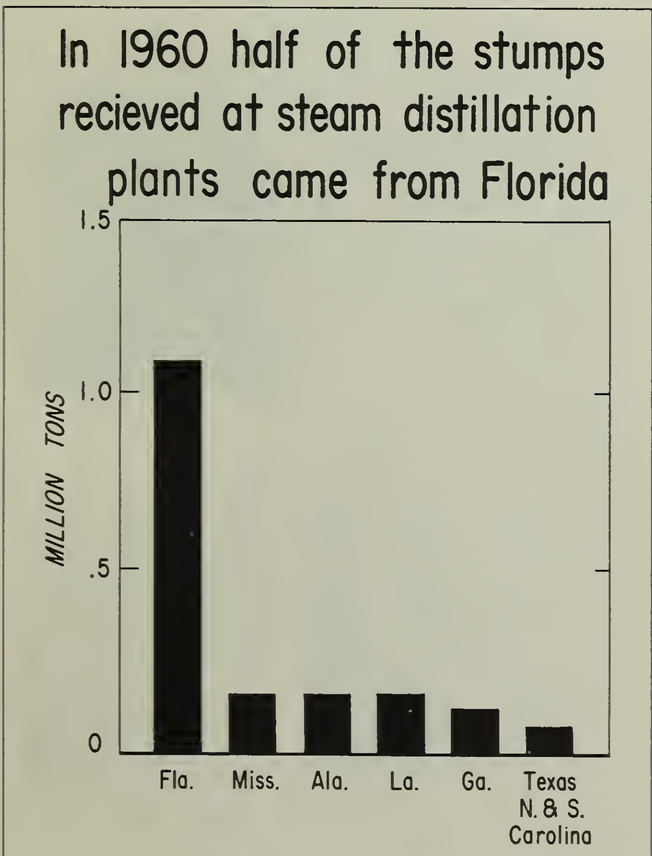

FIGURE 7

Sulfate Naval Stores Are Produced From Byproducts of Sulfate Pulping

The sulfate naval stores industry is based on formerly wasted byproducts of paper production by the sulfate process. In the sulfate pulping process the pulpwood is debarked, chipped, and cooked in an alkaline solution of sodium hydroxide and sodium sulfide. When resinous softwoods are pulped, sulfate turpentine is condensed from the cooking vapors. The fats and resin in the pulpwood are converted into soaps. These soaps,

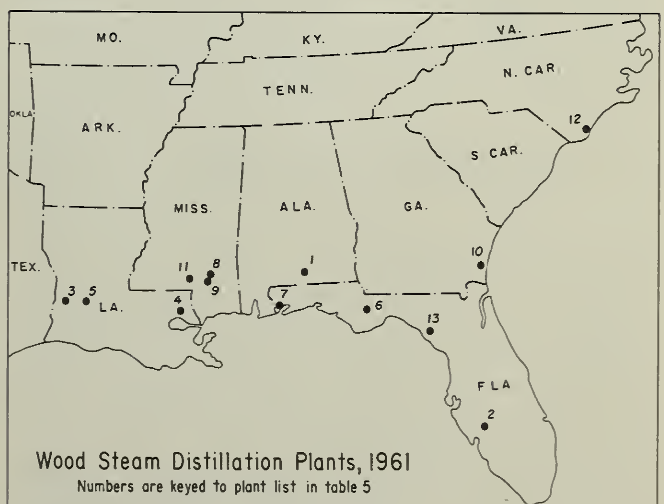

FIGURE 9

from which tall oil is obtained, are skimmed off the spent liquor after the cooking is completed. Sulfuric acid is added to the skimmings, the mixture separates, and the crude tall oil is drawn off. This is used directly or is further processed to improve its odor and color or to change its composition and qualities.

In 1961 practically all of the sulfate pulpmills in the South and one in the West were recovering sulfate turpentine and converting the skimmings from their waste liquors to tall oil. Early in 1962 several mills in the North began to produce tall oil, and recovery facilities are now being installed in several pulpmills in the Pacific Northwest.

About 15 percent of the tall oil recovered is used as such, primarily for flotation oil in the mining industry and in the manufacture of crude soap. About 85 percent of the tall oil produced goes to fractionation plants where it is separated into its two major components, tall oil rosin and fatty acids. Twelve fractionation plants operated in 1961 at locations shown in figure 10 and table 6, and one additional plant was under construction at Portland, Oreg.

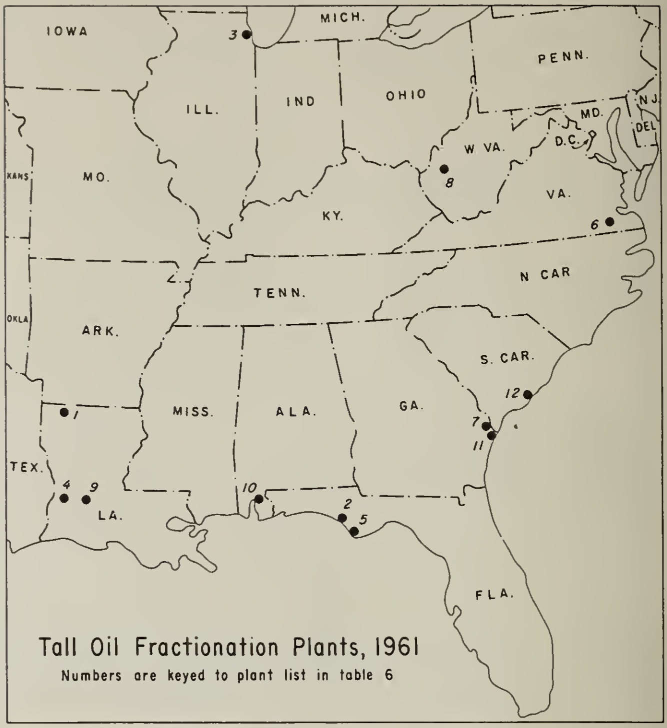

FIGURE 10

DOMESTIC PRODUCTION—PAST TRENDS AND CAPABILITIES FOR FUTURE PRODUCTION

No Trend in Total Domestic Production, But Big Changes in Source

There have been no well-defined trends in total production of rosin and turpentine since the early 1900's (table 7). While showing some fluctuations in response to war and changing economic conditions, production has averaged about 1.7 million drums of rosin and 600,000 barrels of turpentine a year, as illustrated in figures 11 and 12. This average is considerably below the peak production of 2.2 million drums of rosin in 1950 and 750,000 barrels of turpentine in 1908. It is also somewhat below output in 1960 when 2 million drums of rosin and 605,000 barrels of turpentine were produced.

Although there hasn't been much change in total production, there have been significant changes in the sources of rosin and turpentine (figs. 11 and 12). In the early 1900's all rosin and turpentine was obtained from pine gum. Competing supplies of steam distilled wood and sulfate naval stores were developed and by 1959 pine gum was the source of only 17 percent of the rosin and turpentine produced. Most of this decline occurred in the last 30 years. Between 1929 and 1959 production of gum rosin fell from 1.7 to 0.3 million drums, and gum turpentine from 625,000 to 107,000 barrels.

In 1960, for the first time in more than a decade, output of both gum rosin and turpentine exceeded production of the preceding year. With further

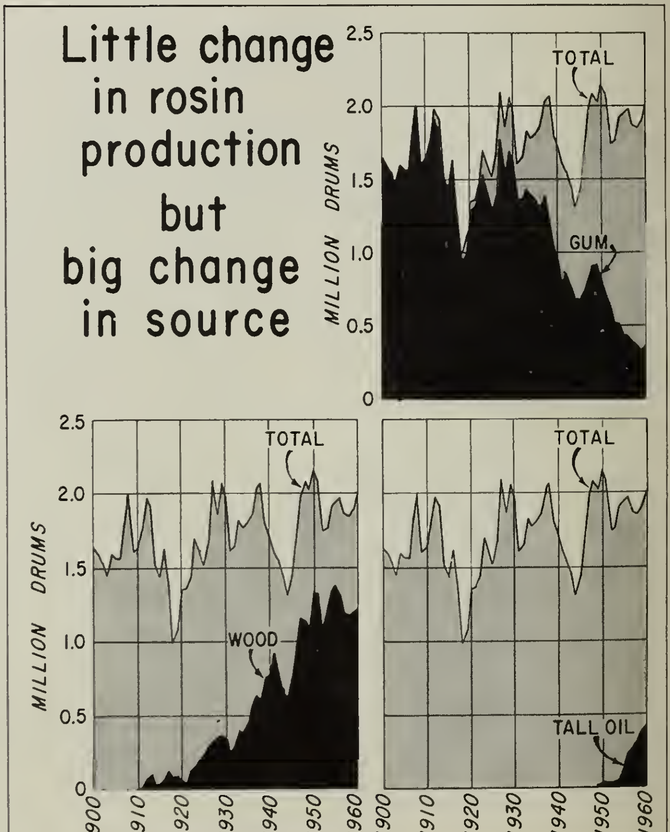

FIGURE 11

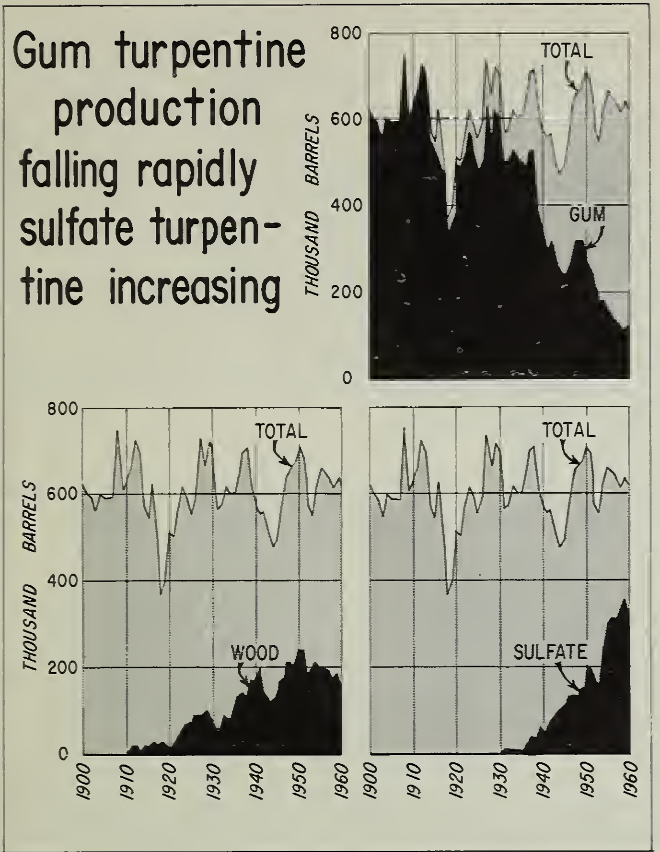

FIGURE 12

increases in 1961, gum rosin and turpentine accounted for 23 percent of all rosin and 24 percent of all turpentine produced (table 7).

More than half of all rosin is now obtained from steam distilled wood. The shift away from pine gum began in 1910 when the first wood steam distillation plant went into operation. After a few years of research and development, production of steam distilled wood rosin began to expand rapidly. It reached a peak of 1.4 million drums in 1955. Since then, however, there has been a gradual decline to the 1961 level of 1.1 million drums. Production of steam distilled wood turpentine has followed a somewhat similar trend, reaching a peak of 243,000 barrels in 1950 with a subsequent decline to 151,000 barrels in 1961. Steam distilled wood rosin and turpentine accounted for 54 and 24 percent, respectively, of total 1961 output from all sources.

Commercial production of sulfate turpentine began in 1928 and of tall oil rosin in 1949. The output of both products has increased rapidly, and in 1961 some 471,000 drums of rosin and 333,000 barrels of turpentine were produced. In 1961 tall oil rosin and sulfate turpentine represented 23 and 52 percent, respectively, of total rosin and turpentine output.

Many Factors Affect the Nation's Capabilities To Produce Naval Stores

Factors such as the availability of suitable timber, labor, capital, and credit must be considered in appraising the capabilities of the United States to produce gum naval stores. Future production of steam distilled wood naval stores will depend mainly upon the availability of old-growth southern pine stumpwood. Potential production of tall oil rosin and sulfate turpentine will be limited primarily by the level of future sulfate pulp production. These and other factors affecting our domestic production potential are discussed in this section.

Timber Resources Greatly Exceed Present Requirements for Gum Production

The longleaf-slash pine timber type in the forests of the naval stores belt, from the Carolinas to Texas, cover about 25 million acres according to the most recent forest survey data for these States (table 8). About 5 million acres of this area now have stands of pine suitable for gum production.[2] Trees on less than 1.5 million acres were worked for naval stores in 1960.

A comparison of the number of faces worked with the number of sawtimber-size pines in unworked stands shows that sufficient timber is available for an appreciable expansion in gum production. About 30 million faces were worked during the 1960 crop year, according to records of the Naval Stores Conservation Program of the USDA Forest Service (fig. 13 and table 9). Unworked stands suitable for gum production now contain 160 million sawtimber-size longleaf and slash pines—more than five times the number worked in 1960 (fig. 14). Millions of additional large unworked pines exist in stands now being worked and in stands lacking sufficient large pines to qualify as suitable for gum production. Even in southern Georgia, where 82 percent of all working faces are located, unworked stands suitable for gum production contain 38 million sawtimber-size pines, compared with 24 million faces worked during the 1960 crop year.

Availability of Timber Depends on Landowner's Policies

All suitable longleaf and slash pine trees in the South are not available to the naval stores industry. Largely because of the production methods used in the past, many landowners did not permit gum operations on their lands. Destructive gum pro-

[2] Stands are considered suitable with a minimum of 15 longleaf or slash pine sawtimber trees (9 inches and larger d.b.h.) per acre in Alabama, Mississippi, Louisiana, and Texas, and 20 per acre in the Carolinas, Georgia, and Florida.

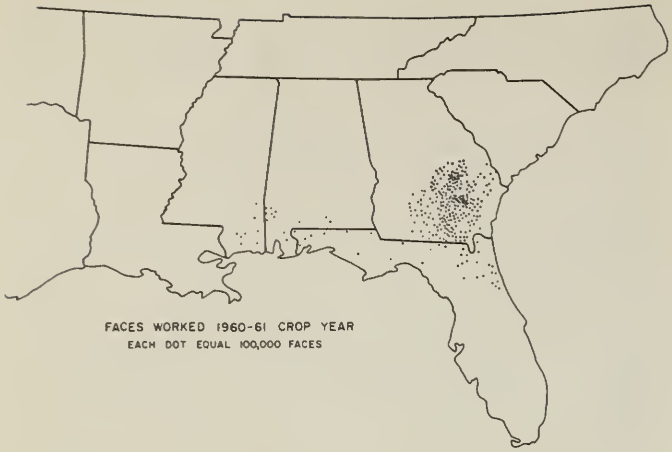

FIGURE 13.—Eighty-two percent of the 30 million faces worked during the 1960 crop year were in Georgia.

duction methods resulted in severe damage to the timber. Frequent deep chipping of small pines weakened the trees and made them vulnerable to windthrow, fire, insects, and diseases. Nails and other hardware left in worked-out trees reduced their value for timber products.

This situation has been greatly improved in recent years through widespread adoption of modern gum production methods developed by the Forest Service. These include bark chipping with sulfuric acid treatment which does not damage the wood, use of easily removed double-headed nails for fastening cups and gutters, and cupping only selected trees of at least 9 inches in diameter. Modern conservation methods are now used almost exclusively by the gum industry, prices paid for timber leases have increased, and the attitude of most landowners toward leasing their timber for gum production is much more favorable than in the past. Except for a few of the largest operators in Georgia, gum producers were able to lease all the timber desired in 1961.

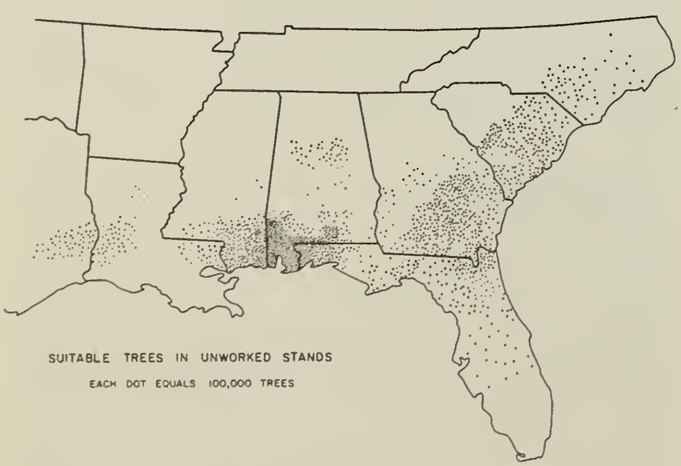

FIGURE 14.—Unworked stands suitable for gum production contain 160 million large pines—more than five times the number worked in 1960.

Landowner policies regarding leasing are very important since half of all faces worked in 1961 were on leased timber. Results of a 1961 survey of 360 gum producers indicate that small producers generally work their own timber. Less than 4 percent of the faces worked by small producers with less than 10,000 faces each were on leased timber. On the other hand, much of the timber worked by large gum operators is leased. More than one-third of the faces worked by producers with 10,000 to 50,000 faces each, and three-fourths of all faces worked by those with 50,000 or more faces were on leased timber (fig. 15). These latter two groups operated more than two-thirds of all faces worked in 1960.

Policies of Forest Industries and National Forests a Key Factor

The availability of timber for gum production in the future will depend greatly on the policies of forest industries and national forests. About 30 percent of the commercial forest land in the naval stores area is owned by forest industries, primarily pulp and paper companies, and an additional 10 percent is in public ownership, mainly in national forests (table 10). The remaining 60 percent is divided about evenly between farm and other private landowners. A considerable portion of this latter area is controlled by forest industries under long-term lease agreements. Thus, forest management policies of industrial owners are of even greater importance than indicated by ownership data.

The best opportunities for commercial gum operations in the future will be in the industrial forests and national forests. Such ownerships generally will offer larger blocks of timber suitable for large gum operations than will the smaller farm and other private woodlands. Even more important, the higher level of forest management generally being conducted in these forests will provide more uniform and heavier pine stocking than on most other lands. The size, vigor, and number of suitable pines per acre are important factors affecting yield and cost of gum production.

Forest industries with large tracts of land in the South vary in their policies regarding timber leases for gum production. A few pulp and paper companies have leased large acreages of pine to gum producers, almost 2 million faces in one case. Several other companies have leased smaller blocks of timber for pilot operations to determine the problems and benefits involved. Others with sizable landholdings have made no contracts. As a result of improved gum production methods and of recent higher prices paid for leases, practically all industrial forest-land owners in gum-producing areas are interested in the possibilities of integrating gum production in their forest management programs.

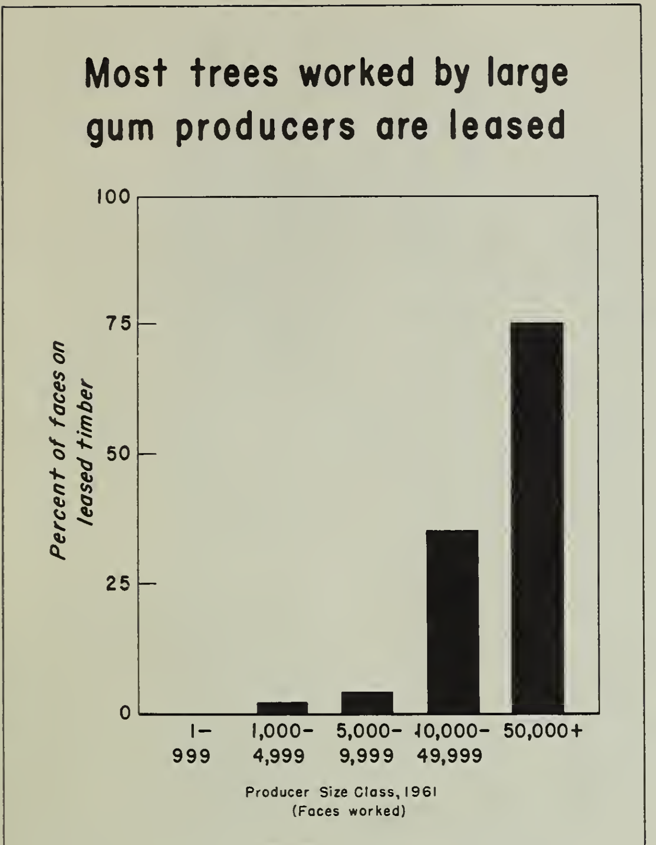

FIGURE 15

The management plans of most large industrial landowners in this area prescribe even-age management of pine on a 30- to 35-year rotation, with clear cutting and planting proposed on large blocks of 500 to 1,000 acres. This system will permit selection of areas to be cut long before harvest date, and thus make possible leasing of timber suitable for gum production for 4 or 5 years prior to harvest. The decisions of most companies regarding leasing will probably depend on the prices paid for leases. If gum producers can continue to pay current lease prices, which amount to about 25 percent of the gum value produced, it appears likely that most large industrial landowners will integrate gum production into their forest operations and make their timber available.

Forest management policies of the national forests favor the leasing of timber for gum production. The national forests are managed under the concept of "multiple use." Gum production can generally be integrated with other uses, and the national forests will lease timber wherever gum production is compatible with other planned forest-land uses.

Present policy on national forests in the South is to grant 3-year leases prior to harvest cuts wherever timber to be cut is suitable for gum production. About 340,000 faces were worked during 1961 in the national forests in Alabama, Florida, and Mississippi. The present level of timber leasing in national forests is limited primarily by two factors. First, most gum producers prefer leases for more than 3 years, but this is considered the maximum time that the national forests can allow. Time required to mark timber and set up a sale, plus 3 years for gum production leases, plus 2 years usually allowed the timber buyer for logging, add up to a 6- or 7-year interval between the time a sale area is selected and logging is completed. Second, many national forest stands are young stands in which stocking is being built up through light improvement cuts. The size and number of trees per acre to be removed in current sales often are too small to support efficient gum production operations. Opportunities for gum production from leased national forest timber will be much greater in the future when pine stocking is built up and timber sales include more trees per acre of larger size than at present.

Gum and Timber Production Can Be Integrated Profitably

Additional profits generally can be obtained from longleaf and slash pine stands by proper management for production of gum as well as timber products. With modern extraction methods, producers can obtain a substantial amount of gum from their timber and then utilize the worked-out trees for lumber or woodpulp. Timber degrade due to pitch soaking resulting from gum production is negligible. Unburned, metal-free, bark-chipped timber returns about the same stumpage prices for saw logs and pulpwood as unworked trees.

Timber growth is reduced by gum production.—The loss in growth is relatively small and its value is greatly outweighed by the returns from gum. Many variables such as climate, site capabilities, skill of the chipper, and age and vigor of the trees complicate calculations of growth loss due to gum production. Several research studies (*8*, *13*, and *16*)[3] indicate that annual growth may be reduced about 25 percent each year when one face on a tree is worked. Two faces may reduce annual growth 40 to 50 percent. Growth loss for double-faced trees is the same whether the faces are worked simultaneously or in succession.

These growth reductions apply only to the growth of trees during the time they are worked. When this annual growth reduction is compared to the total merchantable volume of the tree, the actual percent of wood volume not produced is relatively small. Assuming a diameter growth rate of 1 inch in 4 years for a 10-inch slash pine, a 25-percent reduction in growth during a 4-year naval stores cycle would result in less than a 6-percent loss in the merchantable cubic-foot volume at time of harvest.

[3] Italic figures in parentheses refer to Literature Cited, p. 59.

Gum yield exceeds growth loss in value.—The stumpage value of pulpwood growth lost annually, for a 10-inch slash pine, is about 2 cents (table 11). The gross value of gum produced annually from a 10-inch slash pine by modern extraction methods is about 68 cents. The costs of extracting gum generally amount to about half of the gum value, indicating for this example a net value of 34 cents for gum and a ratio for gum yield compared to pulpwood stumpage value lost of more than 15 to 1. Similar comparisons for 12- and 14-inch pines are included in figure 16 and table 11.

Fire, Insect, and Disease Hazard Not a Serious Deterrent

With modern extraction methods and adequate woods supervision, tree mortality in stands operated for naval stores under normal climatic conditions is generally about the same as in unworked stands. Higher losses may be experienced in specific instances such as insect outbreaks following timber cutting in or near areas being worked for gum, or insect and disease problems in stands operated for naval stores before recovery from severe drought or wildfire. When gum operations are coordinated with timber-cutting schedules, as now recommended on integrated gum and timber production operations, timber losses due to naval stores production are negligible. With such management, trees to be harvested are selected and marked several years before the harvest date. Only these trees selected for harvest are cupped, and any that die during the naval stores operation are later salvaged in the subsequent timber harvest.

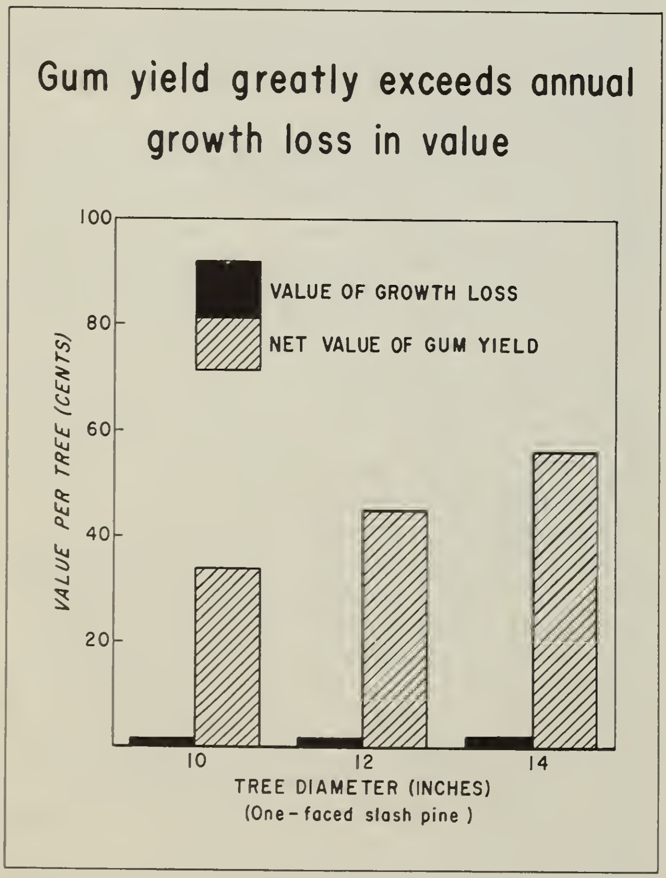

Figure 16

The frequency of wildfires is not affected by gum operations.—The Forest Service has no evidence indicating a greater frequency of wildfires in stands worked for naval stores than in unworked stands. Many naval stores stands are prescribed burned immediately before installation of cups, thus reducing the chances of serious wildfires during the period of gum production (fig. 17). Many timber owners consider naval stores leases a form of protection from fire, since the lessee has a sizable investment in equipment and supplies which he must protect.

When a wildfire does occur in a stand being worked for naval stores, the resulting damage generally is worse than in an unworked stand. Principal damage results from severe charring of tree faces which degrades the butt logs of the trees for either pulpwood or saw logs, from crown scorch or destruction which may kill trees outright, or from insects and diseases that often get started in fire-weakened trees. Dry face, a condition causing cessation of gum flow, often occurs when chipping is resumed after a severe fire. Repeated fires in naval stores timber also may result in "catfaces" and, as a consequence, occasional windthrow.

Early studies by Harper (*14*) at Lake City, Fla., on the other hand, showed that gum production from a back face was not affected by light fires on the front face, and that burning of the ground cover may actually have a beneficial effect on gum yield if the faces are protected from fire. Heavy burning, of course, can be very destructive and makes necessary deferment of gum production until the stand recovers.

The rate of fire spread in naval stores stands generally is no worse than in unworked stands except under the most severe conditions. In high-intensity fires radiant heat may melt hardened gum and ignite faces in advance of the main fire head, but this is not a common occurrence.

Mopup and control following fire are more difficult and time consuming in naval stores stands than in unworked stands because of flammable gum on the trees and in the cups. This increased difficulty in control, however, may be at least partly offset by the frequent presence of the gum producer, his efforts to protect his additional investment, and his or the landowner's prescribed burning program.

Some diseases are directly associated with naval stores operations.—The three of most concern to naval stores producers are dry face, pitch streak, and pitch canker. In addition there are a number of other important diseases which

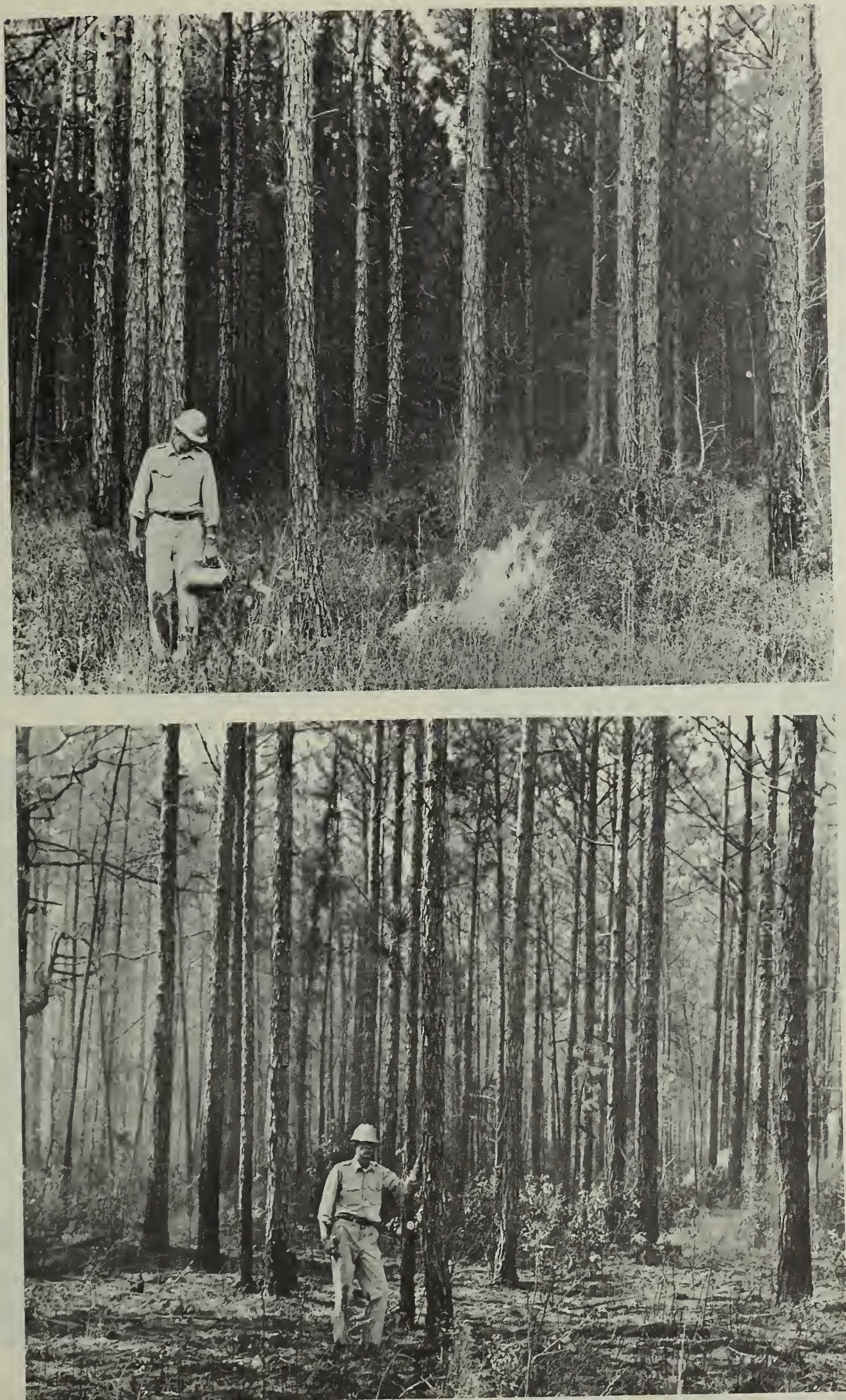

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FIGURE 17.—Many naval stores stands are prescribed burned immediately before installation of cups to reduce hazard from wildfires. (Before and after prescribed burn.)

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cause losses in longleaf and slash pine stands that are not particularly associated with gum operations. These include fusiform rust, annosus root rot, brown spot, and cone rust.

Dry face is a condition of naval stores pines in which there is a permanent cessation of gum flow from a part or all of the pine face (*17*). Dry face has occurred as early as the third year of work on front faces, but usually occurs later on back faces. Where trees are not harvested promptly after completion of gum production, these dry areas are frequently attacked by insects and fungi which cause stain and decay that reduce the quality of the wood. Dry face is more common on slash pine than longleaf, and its occurrence increases during periods of drought. Losses from dry face have been greatly reduced in recent years by use of improved gum production methods, good management of naval stores stands before gum production is started, and prompt harvesting of worked-out trees.

Pitch streak is practically confined to trees worked for gum, and appears as an accentuated form of dry face whereby the whole side of the tree above a face may die, exude gum, and become pitch soaked. The factors contributing to the disorder are similar to those related to dry face, including naval stores practices, site and stand factors, weather conditions, and fungi. During prolonged periods of drought, such as occurred in the 1930's and 1950's, pitch streak can cause important losses, especially among shallow-rooted pines near pond margins and in trees with a low proportion of total height in live crown.

Pitch canker is caused by the fungus *Fusarium lateritium pini*. It kills small longleaf and slash pines and also causes deep pitch soaking in larger pines behind infected areas, including infected faces. Much of the difficulty in getting preservative penetration behind the faced portions of some pine poles is believed due to heavy pitch infiltration resulting from *Fusarium* infection.

Diseases in general are responsible for reducing production of naval stores by possibly about 5 percent, with dry face and pitch streak responsible for well over half of this loss. Especially during periods of moisture stress, disease losses can be high in local areas. However, with modern gum extraction techniques, chipping only trees of medium-to-high vigor, and prompt removal of worked-out trees, disease losses should not be a serious problem.

Three types of insects are of special concern to naval stores producers.—They are the black turpentine beetle (*Dendroctonus terebrans*), the engraver beetles (*Ips* spp.), and the turpentine borer (*Buprestis apricans*). Several other species of bark beetles also cause damage in southern pine stands, but are not particularly associated with naval stores operations.

The black turpentine beetle caused heavy mortality in southern pine stands during the severe and prolonged drought of the early 1950's. Adult beetles deposit eggs along tunnels in the inner bark of trees. The larvae from these eggs feed on the inner bark and often eat enough of it to girdle the tree. Timber losses in the South caused by outbreaks of this insect from 1949 through 1958 were recently estimated by Thatcher (*22*) at more than 100 million board feet and 45,000 cords. Today this beetle continues to cause a steady loss of pines in the Gulf Coastal Plain even in the absence of drought conditions (fig. 18). Black turpentine beetle attacks are most frequent in stands disturbed by fire, logging, climatic conditions, or outbreaks of other insects, or by naval stores operations, according to studies by Smith and Lee (*20*). The beetles seldom persist at high populations for more than a year or two, except in naval stores stands where attacks may continue for 3 to 5 years if not controlled. They can be controlled through use of a BHC (benzine hexachloride) diesel oil solution as a postattack spray (*19*). If properly applied and maintained, this control procedure will reduce losses normally caused by the beetle about 90 percent.

Ips engraver beetles prefer recently killed pines and slash from summer logging, but are capable of breeding in trunks and limbs of apparently healthy trees. Naval stores trees, especially when weakened by improper gum production methods,

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FIGURE 18.—The most obvious signs of black turpentine beetle attack are pitch tubes on the lower trunk of trees and on stumps.

are subject to attack. When populations have built up in green felled timber or fresh slash and there are no additional slash, logs, or weakened trees available, they will attack healthy trees and sometimes cause considerable damage. The beetles bore through the outer bark to the inner soft layers where they construct narrow egg galleries. The larvae tunnel through the inner bark and, later as young adults, continue to feed beneath the bark before emerging. Trees thus weakened attract other species of beetles which cause additional injuries. Infestations of *Ips* beetles in green timber are usually sporadic and of short duration.

The adult turpentine borer lays its eggs in the seasoned checks or cracks of wood exposed by gum faces, mechanical injuries, or fire scars. The larvae immediately bore into the wood and continue to mine through both sapwood and heartwood for a period of 3 years. The tunnels and "pitching" of surrounding wood lowers the grade of infected logs, and many of the weakened trees break off during later windstorms. As this borer lays its eggs only in seasoned checks of exposed wood, it can best be controlled by protecting southern pine stands from wildfire, and by use of modern conservative gum production techniques to keep naval stores faces covered with pitch and avoid dry facing.

Existing Plants Could Process Two to Three Times the 1960 Gum Crop

The current gum-processing capacity of existing plants is sufficient to accommodate a gum crop twice the size of that produced during the 1960 crop year. Moreover, expansion of crude gum storage facilities could increase the processing capacity of existing plants to about three times the volume of the 1960 crop. Nineteen central processing plants operated during 1960 (fig. 6). Late in 1961 one additional plant was opened to handle gum produced from new operations in Louisiana and Texas.

During the 1960 crop year, the 19 plants processed 622,000 barrels (435 pounds net) of crude pine gum. Plant activity varied considerably with one plant handling 16 percent of the total crop and another as little as 1 percent. The average plant in 1960 operated at 48 percent of current maximum processing capacity. Here again plants varied greatly, with one operating at 86 percent of capacity and another at only 12 percent.

Individual plant capacities range from 2 to 11 percent of the industry total. Georgia plants have 78 percent of overall processing capacity, which is approximately in line with Georgia's 81 percent of total crude gum receipts and 82 percent of all faces worked in 1960. In contrast, Alabama, with less than 5 percent of all 1960 faces, has 8 percent of overall capacity and processed 9 percent of all crude gum receipts in 1960. Apparently more than half of the gum produced in Mississippi and most of that from western Florida is processed in Alabama.

Labor, Capital, and Credit Requirements Do Not Limit Production

The labor supply seems adequate for an appreciable expansion of gum production. No current information is available that shows directly the availability of unemployed gum production laborers, nor of rural male workers in the naval stores area. Indirect evidence, however, indicates that an ample supply of rural manpower is available that could be trained for this purpose over a period of time.

Sufficient labor was available in 1961 to expand gum production about 25 percent above the 1960 level. Most of the 360 producers contacted in the spring survey of 1961 had successfully hired all the laborers desired for their 1961 gum operations. Some producers complained about the quality and reliability of their laborers and the rapid turnover caused by men failing to report for work. Nevertheless, most producers had full crews, and more than 90 percent of them reported that additional men were available. They also reported that most new men hired in 1961 had some previous experience in gum production.

Some labor for an expansion in gum production might be obtained from the large number of woods workers generally engaged in operations of other forest products industries, especially pulpwood logging. This woods labor force in Georgia and Florida, the two principal gum-producing States, has totaled about 35,000 to 40,000 men in recent years. Many of the new laborers hired by gum producers in 1961 were pulpwood loggers temporarily unemployed because of a slackening in demand for round pulpwood. During periods when favorable prices permit payment of reasonable wages for gum production, as is likely when production is being expanded, gum producers should be able to compete for such woods labor.

Farmworkers provide another potential source of labor for gum operations. The number of workers on Georgia and Florida farms in 1960 averaged almost 300,000 (*1*). Based on the national average, about one-fourth of these were hired workers. Farm wage rates in the Southeastern States are generally the lowest in the Nation. Here, in 1960, cash hourly earnings of farmworkers averaged less than 60 cents (*6*). Productive laborers on 1960 gum operations probably averaged twice that amount.

The surplus of U.S. farmworkers in recent years has been greatest in the Southeastern States. The Southeast also has been one of the principal sources of migratory farm labor. More than one-third of all migrant farmworkers who reported in 1958 to State employment security agencies under the nationwide annual worker plan were residents of Florida or Georgia (*5*).

Decreasing job opportunities on farms in the future may force an increasing number of rural youths to seek nonfarm employment. Woods work, including gum production in the southeastern forests, might provide a partial solution to the problem of unemployed and underemployed rural workers in this area.

Capital and credit are available.—Reliable gum producers can obtain sufficient capital and credit to expand gum operations. This is an important factor, especially for the larger gum producers, since as much as 60 cents per tree must be invested before any gum is collected. This investment includes purchase and installation of hardware and the costs of items such as mules, trucks, supervision, and housing.

Housing is generally provided on the larger operations and requires considerable investment. Almost two-thirds of all employees engaged in gum production are housed by their employers, according to results of a 1961 survey. The proportion of employees housed by gum producers increased with size of operation to as high as 87 percent for producers working 50,000 or more faces (fig. 19). Almost half of all gum producers provided some housing for their employees, with the proportion again increasing with size of operation to 94 percent of the producers with 50,000 or more faces.

Availability of capital and credit was sufficient in 1961 to expand gum production 25 percent over the preceding year, and most operators believed they could have obtained funds for additional expansion if desired. Credit was obtained for 1961 operations by about one-fifth of the gum producers contacted in the 1961 survey. Relatively few of the smaller producers needed or obtained credit, whereas more than half of the producers with 50,000 or more faces obtained credit for their 1961 gum operations (fig. 20).

Credit and loans for gum operations are available from several sources. More than half of the producers who reported using credit in 1961 operations obtained it from the operators of gum-processing plants. An additional one-third obtained loans from banks, and the remaining 8 percent secured credit or loans from individuals, loan agencies, equipment suppliers, or other sources.

Federal Price Support and Assistance Programs Aid the Gum Naval Stores Industry

Price-support program has stabilized supplies and prices and contributed to marketing progress.—The naval stores price-support program has succeeded over and above its main ob-

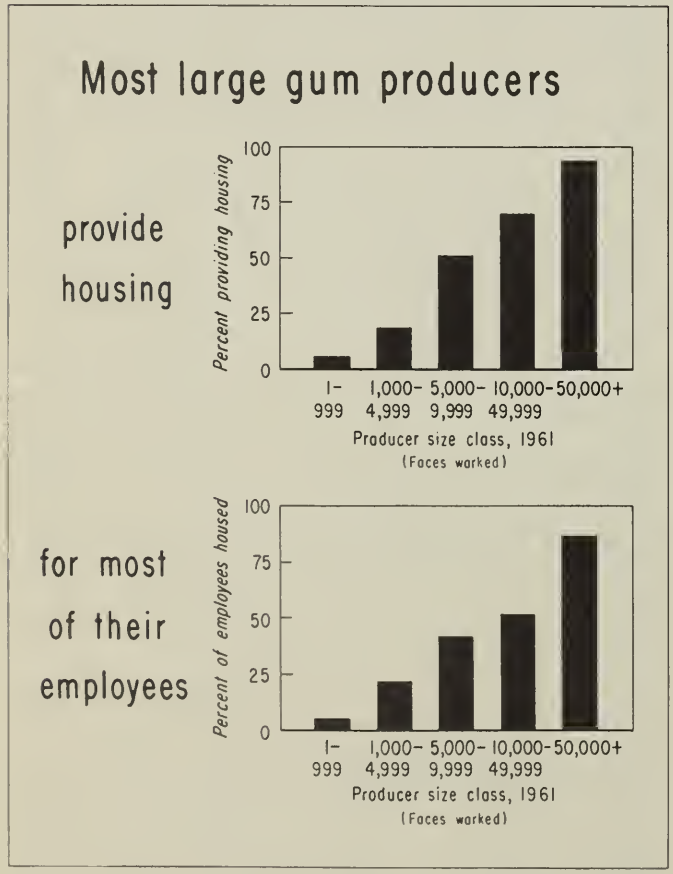

FIGURE 19

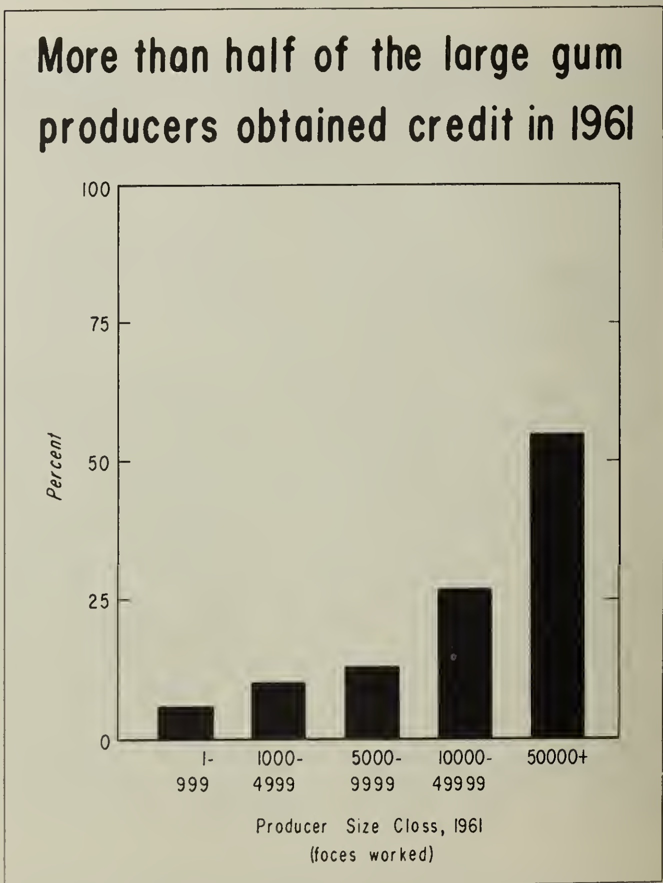

FIGURE 20

jectives. Year in, year out, the main objective of the Commodity Credit Corporation (CCC) naval stores program has been to enhance the income of gum farmers by supporting the price of gum naval stores. Over and above this main objective, in times of acute shortage and during wartime, the program was intended to encourage consumption by bringing more stability to the market. Neither noteworthy contributions to progress in producing and marketing naval stores nor a favorable financial outcome are normally to be expected to result from nonrecourse loan operations. Yet the program has achieved successes in these directions while achieving its principal objectives.

Price-support operations for gum naval stores are permissive under currently applicable legislation, the Agricultural Act of 1949, as amended. CCC price-support operations on gum naval stores began in 1934 and have been continuous since 1938. Basically, support has been extended through the nonrecourse loan technique. However, in 1934 and 1935, loans to producers were made in conjunction with a marketing agreement and licensing program, and in 1942–44 loan operations were supplemented by purchase programs to stimulate needed production. The program is administered by the Naval Stores Branch, Tobacco Division, Agricultural Stabilization and Conservation Service, with the American Turpentine Farmers Association Cooperative, Valdosta, Ga., acting as field agent.

Over the whole series of price-support programs through May 31, 1962, CCC had made loans on, or purchased outright, more than 4.6 million drums of rosin and 1¼ million barrels of turpentine involving gross disbursements of nearly $140 million. In the aggregate, these loan operations involved nearly 10 times the volume the gum rosin crop and more than 8 times the volume of gum turpentine produced in the 1961 crop year.

As of May 31, 1962, all of these stocks had been sold except for 35,000 barrels of turpentine acquired by CCC under the 1960 program for which a competitive-offer sales program is in operation. CCC also held as collateral, subject to redemption under the 1961 and 1962 programs, 143,000 drums of gum rosin. These CCC stocks, acquired and loan, constitute less than 3 weeks supply of all types of U.S. turpentine and less than a month's supply of all kinds of rosin.

Program is worldwide in effect.—Ramifications of the program with respect to prices, production, and demand have been worldwide. Since other types of naval stores are widely considered to be practically interchangeable with the gum products for most uses, price support for gum naval stores inevitably supports the market for all types of naval stores, including those produced abroad. Other types of naval stores, however, and especially foreign products, often are sold at prices below those for American gum naval stores.

Program helps relieve distress market situations.—During the 1930's, the program provided relief from distressingly low prices. For example, rosin prices averaged only $1.23 per 100 pounds net during the crop year beginning April 1, 1932. In 1938, it seems reasonable to assume that if the 35 percent of gum turpentine output and 53 percent of the gum rosin crop, which was acquired by CCC, had instead been placed on the market, the prices received by producers (16.6 cents per gallon of turpentine and $2.18 per 100 pounds of rosin) would have been much lower, considering the relative inelasticity of demand for these products. Without the loans, additional gum farmers would have been forced out of business at a time when they and their laborers had very limited alternative opportunities of employment and the decline in gum naval stores production doubtlessly would have been far more severe.

Program encourages production.—During wartime and other periods of severe shortage, the program was intended to encourage production, an objective achieved in 1942, 1947, and 1948. The increased output of 1960–62 was stimulated by market rather than support prices. The higher support prices were not always sufficient in themselves to increase the production of gum naval stores although no doubt output was maintained at a higher level than would have been the case without price support. Production depends heavily on hand labor which, during time of war and rapid industrial expansion, is siphoned off by demands of the Armed Forces and high-wage industries.

Program helps stabilize prices.—The program has been the principal stabilizing influence on naval stores prices. By reducing open-market supplies through pledges during weak market periods and increasing these supplies through redemptions and sales in times of shortages, the program has tended to stabilize prices (fig. 21 and table 12). Before the price-support program began, rosin and turpentine prices fluctuated widely. For example, gum turpentine prices rose from $0.36 per gallon in 1917 to $1.50 in 1920, fell to $0.57 in 1921, rose to $1.14 in 1922, and so on. Rosin price gyrations were similar. In contrast, except for periods when the price-support program was inactive and CCC inventories were exhausted or frozen, turpentine prices were relatively steady during the entire postwar period until CCC rosin stocks were exhausted. By stabilizing prices, the support program encouraged naval stores consumption in an increasing number of industries. Most industrial consumers are wary of commodities with a history of widely varying prices.

Program contributes to production and marketing progress.—The program has contributed significantly to the solution of specific production and marketing problems. By limiting sales commissions and interest rates to be charged producers by lienholders, the program eliminated flagrant

Price support program stabilized prices of gum rosin and gum turpentine during the fifties

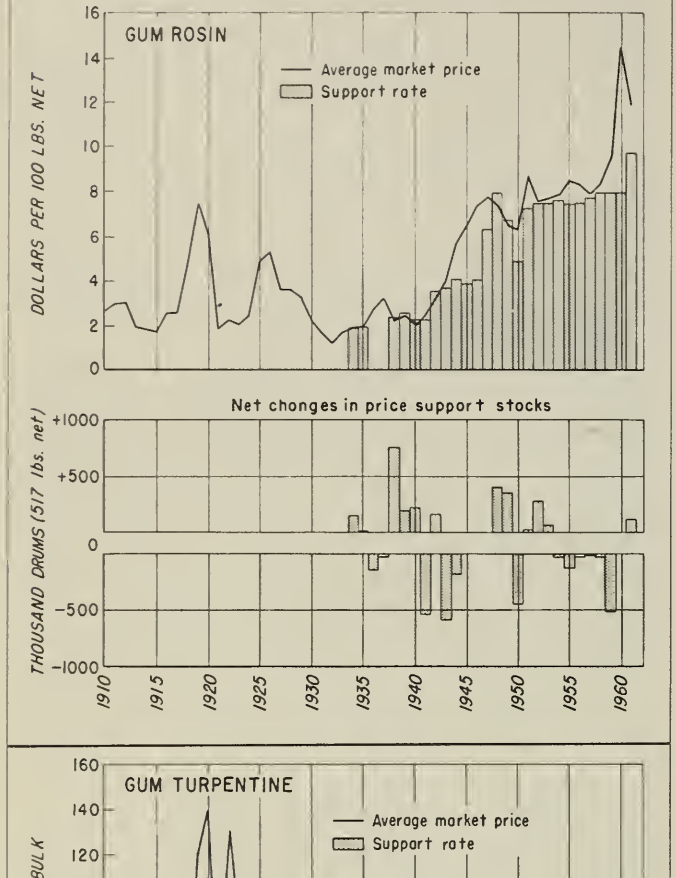

FIGURE 21

abuses which were all too common in the era before price supports.

The program also has been instrumental in improving marketing practices. It changed the basis of rosin trading from a mythical barrel of 280 pounds gross to the 100 pounds net sales unit which made values easier to compute and which was adaptable to various methods of packing. Also, selling turpentine on a weight basis instead of gage gallons reduced marketing costs by eliminating the necessity of making temperature adjustments to determine quantity. The program also promoted the shift from nondescript wood (slack) barrels to metal drums as the principal container for rosin. This reduced marketing costs by virtually eliminating qualitative and quantitative losses. It enhanced the competitive position of rosin, particularly in export trade, and made possible the maintenance of CCC stocks in merchantable condition over extended periods, resulting in timely and advantageous liquidation. Finally, action taken under the program to reduce acidity in turpentine improved quality, storability, and marketability of the product. CCC developed inexpensive and simple methods of field testing for acidity, suggested remedial techniques for elimination of high acid content, and incorporated acidity limitations in the loan eligibility requirements.

Program has involved no loss to CCC over book value.—Over the entire series of programs through the completed 1959 program, CCC has conducted its naval stores operations so that sales proceeds have exceeded book value by $1½ million.

The naval stores conservation program provides technical assistance and cost-shares benefits to gum producers.—This is a gum producers' program sponsored by the Federal Government as one phase of the agricultural conservation program authorized by sections 7–17 of the Soil Conservation and Domestic Allotment Act of February 29, 1936, as amended.

The purpose of the naval stores conservation program is to restrict gum production to the more productive timber; to conserve the trees worked; to protect and permit undisturbed growth of unworked trees; and to conserve the soil, water, and timber resources.

The program is administered by the Forest Service of the USDA through nine area foresters under the direction of a program supervisor. Technical advice and cost-shares payments are given gum producers who agree to use modern conservation practices. The cost-shares payments are rather minor compared to the value of gum yield, but they do encourage use of recommended practices which improve gum yield and profits while conserving and perpetuating the basic timber resource on which this and other forest industries depend. The area foresters are kept informed of the latest production techniques developed by research, through frequent training

meetings. They in turn promptly pass research recommendations on to the producers through some 6,000 contacts made each year under the program. During 1960, about 86 percent of all faces worked and 65 percent of all producers were in the program.

Gum Production Potential at Least Seven Times 1960 Output

Summarizing points discussed above, there is enough timber, labor, capital, and processing capacity to support a substantial gradual increase in gum production. Assuming widespread field application of the best production techniques and sufficient time to hire more labor, bring new trees into production, and increase processing capacity, it appears possible to produce at least 4.5 million barrels of gum annually with only small increases in price (fig. 22). This potential is more than seven times the 622,000 barrels of gum produced in 1960—enough to supply 2.7 million drums or one-third more rosin than was produced in 1960 from all domestic sources combined.

Actual gum production in the next few years is likely to be far below this potential. Primarily because of lower production costs, much of the demand for naval stores during the next decade probably will be met by steam distilled wood and sulfate naval stores. The level of gum naval stores production will thus be determined by markets rather than supply factors. Markets for gum naval stores will in turn depend on the availability of competing steam distilled wood and sulfate naval stores, and the overall demand for naval stores of all types for domestic use and export.

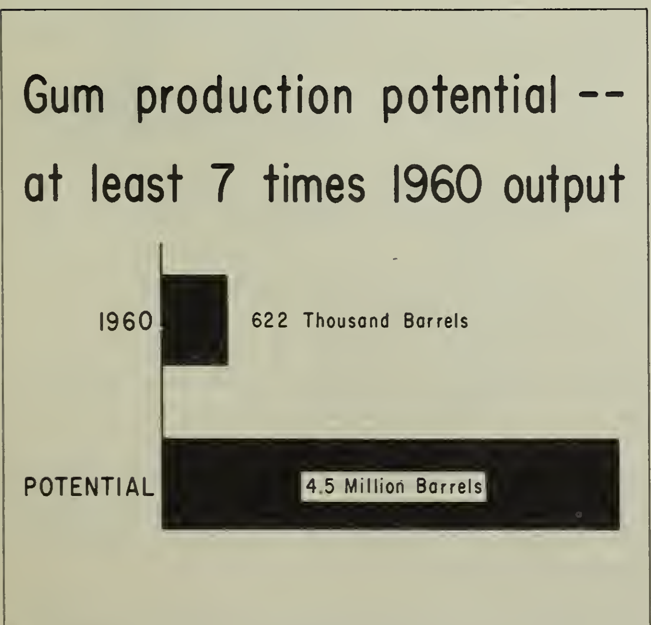

Figure 22

Future Supplies of Steam Distilled Wood Naval Stores Depend on Availability of Stumpwood

More than half of all rosin and about one-fourth of all turpentine produced in the United States during 1961 were extracted by steam distillation from seasoned pitch-soaked stumps of the original old-growth longleaf and slash pine forests. Stumps from second-growth stands, because of their smaller size and lower pitch content, generally are not suitable for production of naval stores. The uprooting of old stumps thus is essentially a mining operation, with no replacement from second-growth stands. The future supply of steam distilled wood naval stores, therefore, will depend primarily on the future availability of old-growth longleaf and slash pine stumpwood.

Other production factors such as labor, capital, and credit are of relatively little importance in limiting the production capabilities of the industry. Labor requirements for harvesting stumps are relatively small, since this is a highly mechanized operation. The companies engaged in steam distilled wood naval stores production are generally large stable organizations with adequate capital and credit facilities.

Production of the 12 plants operating in 1960 was at about 80 percent of capacity. Plants in Georgia and Florida, which have the largest stump supplies, apparently operated closer to capacity than those in Alabama, Mississippi, and Louisiana. With stumpwood resources constantly declining, total processing capacity is more likely to decrease than increase, as plants are closed in areas where stump supplies are exhausted. Thus processing capacity is not an important factor limiting production of steam distilled naval stores.

Stumpwood Resource Totals 73 Million Tons

The remaining supply of old-growth longleaf and slash pine stumpwood totaled about 73 million tons in 1961, according to the most recent forest survey data for each State, adjusted to 1961 where necessary through use of stumpwood consumption reports from distillation plants and State severance tax records. This resource is distributed over some 27 million acres from the Carolinas to Texas (fig. 23).

Almost two-thirds of the stumpwood resource, about 47 million tons, is located in Florida and Georgia (table 13). Less than one-fourth, about 17 million tons, remains in widely scattered locations from Alabama to Texas. The remaining 12 percent, about 9 million tons, is in North and South Carolina, where relatively little stumpwood has been harvested.

48 Million Tons of Stumps Presently Operable

About two-thirds of the stumpwood resource, or 48 million tons, is presently operable. These stumps are on areas of at least 25 contiguous acres with stumps where topography is suitable for push-dozer operation and stumps can be removed without excessive damage to surrounding trees. As with total volume, Florida and Georgia have the largest supplies of operable stumps, about 18 and 14 million tons, respectively (fig. 24). In States west of Georgia, which in recent years have supplied about 40 percent of all stumpwood consumed, the remaining operable stump supply totals about 9 million tons. North and South Carolina together have about 7 million tons.

An additional 19 million tons of stumpwood, about one-fourth of the total resource, is potentially available. These potentially available stumps will become operable as the surrounding timber stands, which now prevent their removal, are opened up by thinning operations or removed by harvest cuts.

Almost 6 million tons, or 8 percent of the total southern pine stumpwood resource, probably can never be harvested. These marginal or inaccessible stumps are on areas lacking sufficient concentration of stumps to be economically operable or on areas not suitable for push-dozer operation, primarily wet swamplands.

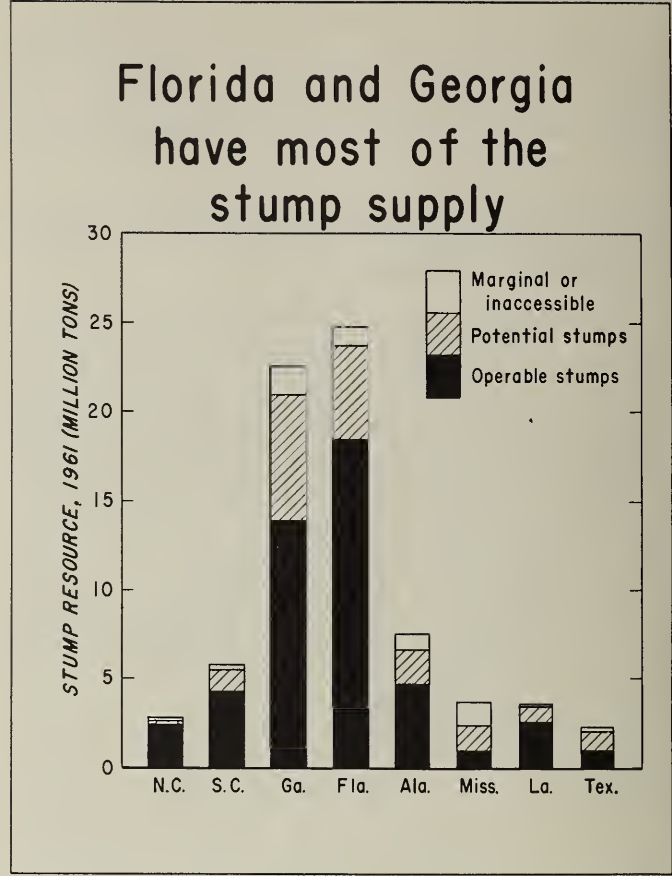

FIGURE 24

Ponderosa Pine—Possible Source of Additional Stumpwood

Ponderosa pine in Western United States might provide a new domestic source of stumpwood for naval stores (fig. 25). Interest in this possibility is increasing as supplies of southern pine stumpwood diminish.

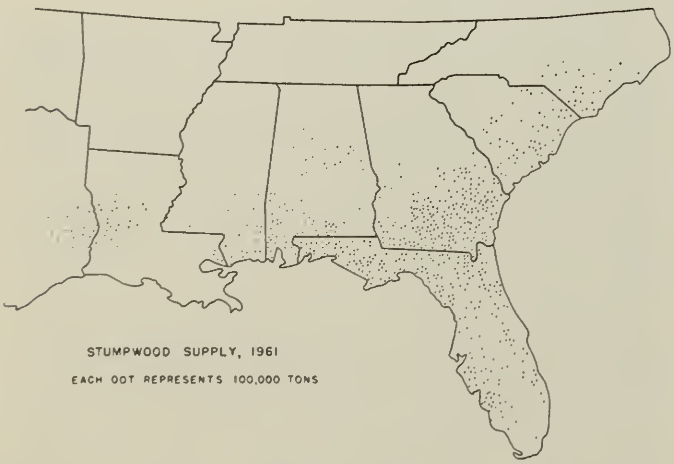

FIGURE 23.—The 73 million tons of remaining stumpwood is distributed over 27 million acres from the Carolinas to Texas.

The most promising areas for ponderosa stump procurement are located in Oregon, Washington, and Arizona, with additional smaller areas in several other Western States (fig. 26). These areas total about 10 million acres. Stumps on other areas in the 38 million acres of ponderosa pine forest type are considered too scattered or inaccessible for naval stores operations.

The supply of ponderosa stumps on forest lands of all ownerships in these most promising areas totals about 24 million tons [4] (table 9). More than half of this ponderosa stump supply, some 13 million tons, is located in Oregon (fig. 27). Washington and Arizona rank next, with 2 to 3 million tons each. The remaining 5 million tons is divided among five other States.

Only 6 million tons, less than one-fourth of this ponderosa stump supply, is considered currently operable. These are stumps cut prior to 1940 from which the sapwood has rotted away, and which can be removed by bulldozers without excessive erosion or damage to surrounding trees. Almost half of this operable stumpwood, 2.7 million tons, is in Oregon (table 14).

[4] Tons in terms of 20-year or older stumps—weights expected when stumps cut since 1940 reach age 20.

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FIGURE 25.—Ponderosa pine stumps may provide a new source of naval stores.

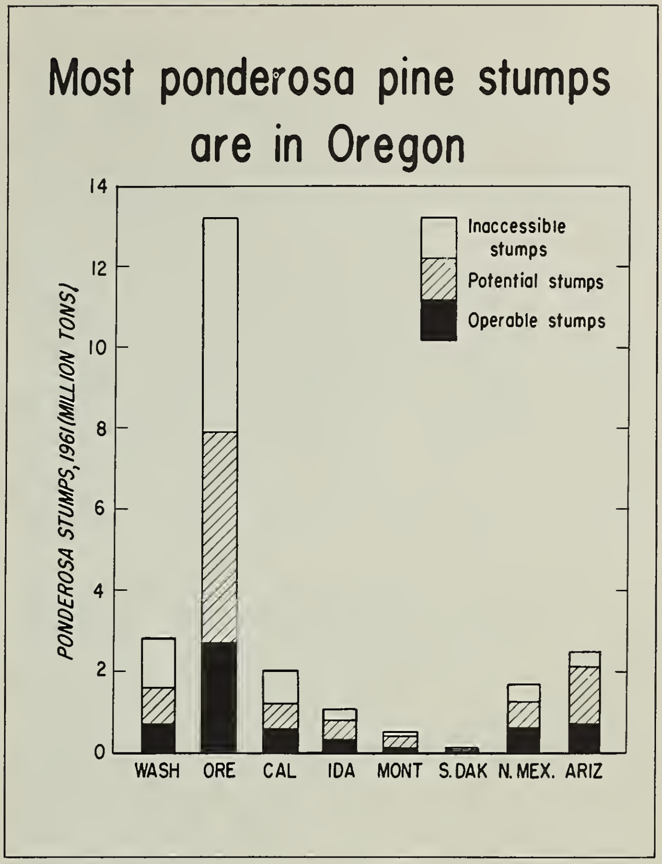

FIGURE 27

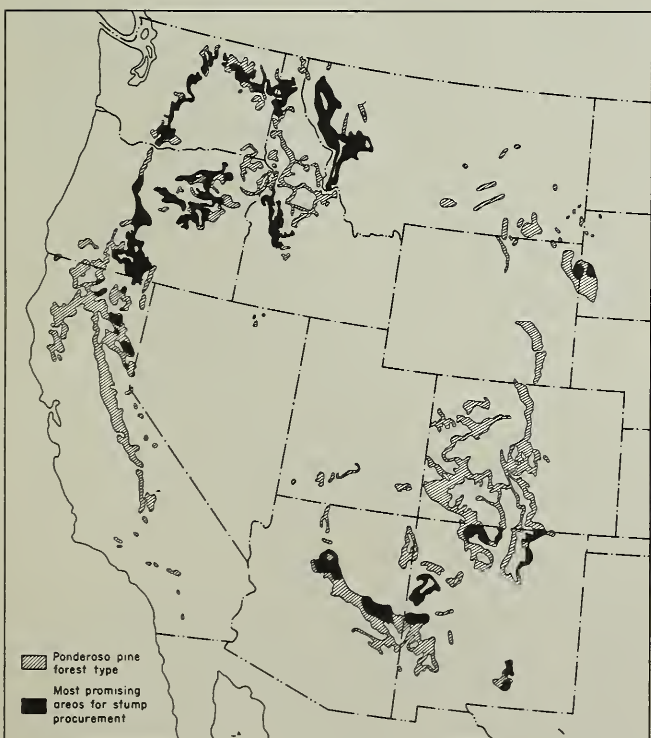

FIGURE 26.—The most promising areas for stump procurement in the 38 million acres of ponderosa pine forest type are mainly in Oregon, Washington, and Arizona.

An additional 10 million tons, about 40 percent of the total supply, is potentially operable. These stumps were cut since 1940 and will become operable when they age sufficiently to lose their sapwood.

Another 8 million tons, about one-third of the total, is considered inaccessible because of the density of young forest growth or the danger of excessive erosion if they are removed. Little, if any, of this volume will be available in the immediate future. In contrast to southern pine stands which often are thinned for pulpwood by age 15 and clear cut between ages 35 and 50, ponderosa pine stands generally are not opened up by harvest cutting until they are 100 to 150 years in age. Thus, stumps on areas well stocked with ponderosa pine reproduction will not be available until a general market can be developed for materials removed in thinning operations. Such a development in unlikely in the immediate future.

The yield and quality of extractives obtained from ponderosa pine stumps and the feasibility of commercial naval stores production from this source have not been definitely established in published literature. Laboratory investigations by Anderson (*2*, *3*) indicated that yields of extractives from well-seasoned ponderosa pine stumps are lower, but "approach yields from southern

pine stumps." Also, ponderosa stumpwood extract has a lower percentage of desirable resin acids than southern pine extract and a higher proportion of unsaponifiable materials. Rosin from ponderosa stumps has a lower melting point and is darker in color than southern pine rosin. It can be processed to raise the quality to the standards of southern rosins, but this involves extra costs.

A pilot plant was operated in southern Oregon during the early 1950's by one of the major wood rosin companies to determine the feasibility of producing rosin from ponderosa stumps. The operation apparently was uneconomic with wood rosin prices at that time, and the plant was closed. With higher rosin prices or possible reductions in cost, production of wood rosin from ponderosa stumps might develop.

The volume of rosin that might be produced from ponderosa stumps, if this becomes feasible, can only be roughly estimated. Assuming that three-fourths of the 15 million tons of operable and potentially operable stumps could be harvested over a period of two decades, about 0.5 million tons would be available each year. Assuming rosin yields of about three-fourths that of southern pine, this would provide some 200,000 drums of ponderosa rosin annually for 20 years—an annual volume about 10 percent of the 1960 domestic rosin output (fig. 28). New stumps from logging operations during that period and following probably would provide enough ponderosa stumps for continued naval stores production thereafter at about two-thirds of that level.

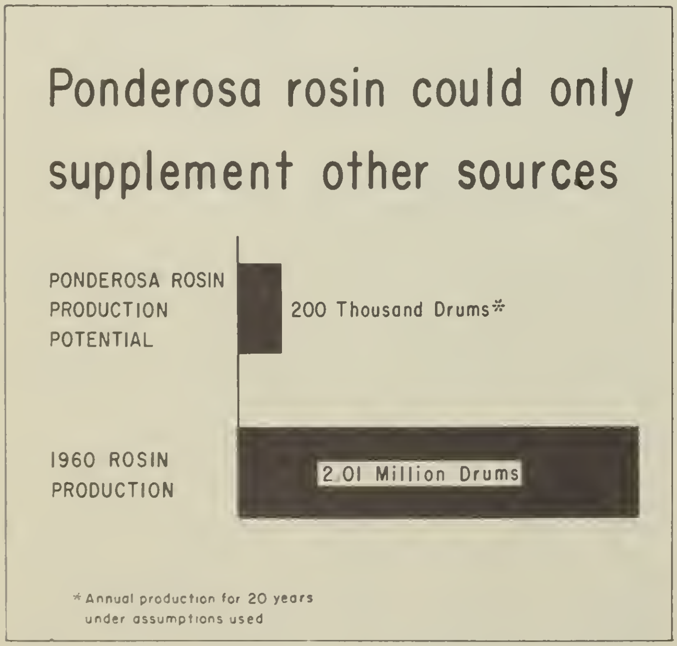

FIGURE 28

Potential for Steam Distilled Wood Naval Stores—Substantial Production for at Least Two More Decades

Steam distilled wood will continue to be an important domestic source of naval stores for at least the next two decades. Even if production from ponderosa pine stumps becomes feasible, the southern pine stump resource will continue to be the most vital factor affecting the industry's future. How long the southern stump resource will last depends on how fast it is consumed, since it is not a renewable resource.

In any attempt to appraise future southern pine stump supplies, some assumptions must be made regarding future conditions. The key assumption in this case, for example, is what action will be taken by companies in the Western Gulf States as their plants are forced to close because of depletion of stump resources in those States. Will they rebuild farther east or go out of business? Since this and other factors cannot be predicted, the outlook for southern pine stump supplies and the production potential for steam distilled wood naval stores from southern stumps has been estimated under various assumptions.

Three general assumptions are made to which all following projections are geared: (1) Thinning or harvest cutting of southern pine stands will make accessible during the next two decades most of the 19 million tons of potentially operable stumps currently unavailable because of tree cover density; (2) distances that stumps can be hauled economically in the future will be about the same as now; and (3) about three-fourths of the remaining resource of operable and potentially operable stumps, or about 55 million tons, can be harvested in the future (some stumps will be lost in wildfires and land clearing, new forest growth will make others inaccessible, and harvesting of some in fringe areas probably will never be profitable).

Under the above assumptions, the life of the southern pine stump resource is estimated under each of three production levels (fig. 29).

Top level.—If plants were relocated as necessary and rosin production was increased to a level 25 percent greater than the 1960 output by 1965 and maintained at that level thereafter, about 1.5 million drums of rosin and 200,000 barrels of turpentine could be produced annually and the stump wood resource would last until 1981—about 20 more years.

Medium level.—If plants were relocated as necessary and production were maintained at the 1960 level of 1.2 million drums of rosin and 163,000 barrels of turpentine, the stump wood resource would last until 1986—about 25 more years.

Lower level.—If no plants were relocated, and each existing plant continued to operate at its 1960 level until depletion of stump resources in the main areas from which it drew stumps in 1960 forced plant closure, the southern stump resource would

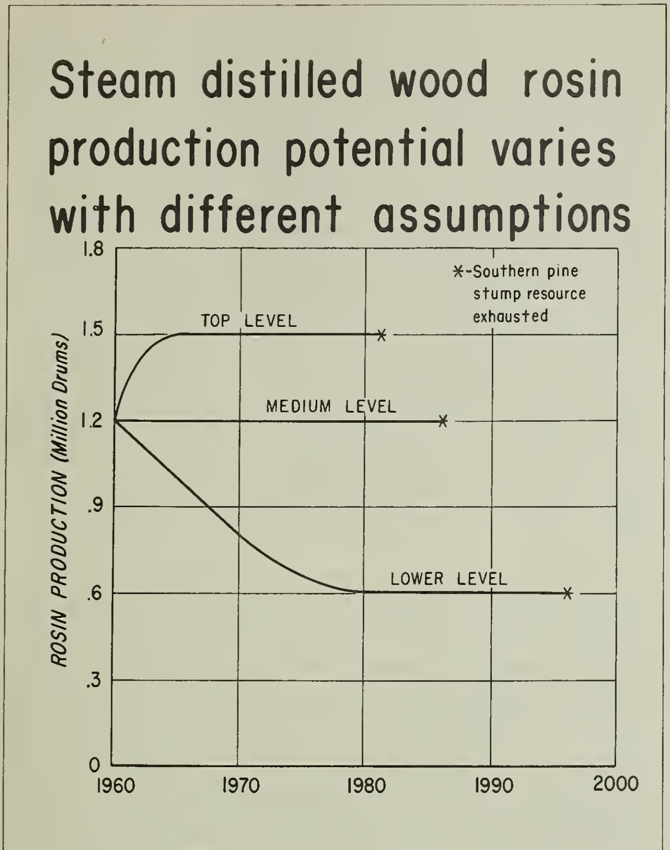

FIGURE 29

last until near the end of the century. Under these conditions, comparisons of individual plant production, stump consumption by plant and State of origin, and stump resources by State indicate the following. Production of rosin would decline to about 0.8 million drums, or two-thirds of the 1960 level, by 1970. By 1980, annual production would be reduced to about half of the 1960 level, 0.6 million drums, and this output could be maintained for 16 additional years until the stump resource was exhausted near the end of the century. The trend in turpentine output would correspond.

These projections merely indicate the overall production potential and probable life of the industry based on southern pine stumps. Actually, production cannot be maintained at any high level up to the point of complete exhaustion of the stump resource. Plant closures will be on an individual plant basis. Production will drop each time a plant is closed without a new replacement, and finally end with closure of the last plant. With any reasonable assumptions, however, it appears that the southern stump wood resource is sufficient to produce substantial quantities of naval stores during the next two decades or more. Actual production in the future will depend on competition, markets, and prices. The outlook for production will be appraised in a following section, after consideration of these additional factors.

Sulfate Naval Stores Potential Depends on Sulfate Pulp Production

The production potential of the sulfate naval stores industry depends primarily on the level of pulp production by the sulfate process, especially from southern pine. Because sulfate naval stores are byproducts of sulfate pulping and are produced by large, well-established companies, labor, capital, and credit requirements are not limiting factors.

Current production of sulfate naval stores is near the maximum possible with the present level of sulfate pulping. Supplies of sulfate turpentine exceed demands, but tall oil from which tall oil rosin and fatty acids are separated is in short supply. Practically all southern kraft mills, which represent more than three-fourths of the Nation's sulfate pulping capacity, are recovering their crude tall oil. Some low-grade tall oil is now produced in the Lake States and Montana, and additional recovery facilities are under construction in the Northwest. Mills pulping softwood species other than southern pine provide sources of some additional tall oil, but this is low in desirable resin acid and fatty acid content and high in unsaponifiables such as pitch and heads. Any appreciable increase in tall oil supplies will depend upon expanded sulfate pulp production from southern pine.

The capacity of existing tall oil fractionation plants (fig. 10) exceeds the supply of tall oil. These plants operated at about 70 percent of capacity during the crop year 1960, and probably have enough capacity to process all of the tall oil that will be available by 1965. Additional fractionation capacity will be built as additional tall oil becomes available.

Continued Increase in Sulfate Pulp Production Expected

Sulfate pulp production is expected to increase substantially to a level of 21.5 million tons per year by 1970. This would be 1½ times the 14.5 million tons produced in 1960, and an average increase for the decade of 4 percent annually.

This projection was made in a recent Forest Service report, "Timber Resources for America's Future" (*12*). As indicated in the source report, this projection is based upon a detailed analysis of trends and developments in the pulp and paper industry. First, projections of demand for the major grades of paper and paperboard were developed, largely from a statistical analysis of relationships between changes in consumption of each grade and changes in population and gross national product. These projections were then converted to woodpulp requirements by type of pulp on the basis of woodpulp use trends in the manufacture of each grade of paper and paperboard.

Production of sulfate pulp was projected from 1952, as indicated by the dotted lines in figure 30. It is apparent that production since 1952 has closely followed the trend level of the projection both in terms of volume produced, as shown by the arithmetic scale, and in rate of increase shown by the semilogarithmic scale. The latter indicates an average annual increase of 4 percent during the next decade, compared to a 6-percent average annual increase attained from 1951 through 1960 and 7.6 percent from 1945 through 1960.

Sulfate Naval Stores Potential by 1970—75 Percent Greater Than 1960 Production

With production of sulfate pulp at 21.5 million tons annually, production of 730,000 drums of tall oil rosin and 560,000 barrels of sulfate turpentine appear possible in 1970. This output would be three-fourths greater than 1960 production.

Most tall oil is produced by southern sulfate mills which process primarily softwood timber. These mills recover about 80 to 90 pounds of tall oil per ton of sulfate pulp produced. Available statistics regarding pulpwood consumption by species at sulfate mills in the various regions were considered inadequate for our purpose. Potential national production of tall oil, therefore, was projected on the basis of total sulfate pulp production in the United States.

During the past 5 years, about 54 pounds of tall oil and 1.2 gallons of sulfate turpentine have been recovered for each ton of sulfate pulp produced in the United States. In the future, some changes will tend to increase these yields and others to lower them.

Yields per ton of sulfate pulp will increase as additional mills in the Northwest and North install recovery equipment, as the older, inefficient recovery equipment in some southern mills is replaced, and as the technology of recovery processes is improved. The potential for additional production in the Northwest and North is relatively small, however, since yields from the species pulped in these areas are appreciably less than from southern pine, and these regions have but a small part of the Nation's sulfate pulping capacity, 15 and 7 percent, respectively, compared to 78 percent in the South.

On the other hand, expansion in the use of hardwood species and chipped residues for pulp will tend to reduce yields of tall oil and turpentine per ton of sulfate pulp produced nationally. In the 12 Southern States where most sulfate mills are located, the proportion of hardwood species in all pulpwood consumed has increased from 10 percent in 1950 to almost 20 percent in 1960 (*7*, *9*). No naval stores are obtained from hardwoods. Use of chipped residues, which yield less naval stores

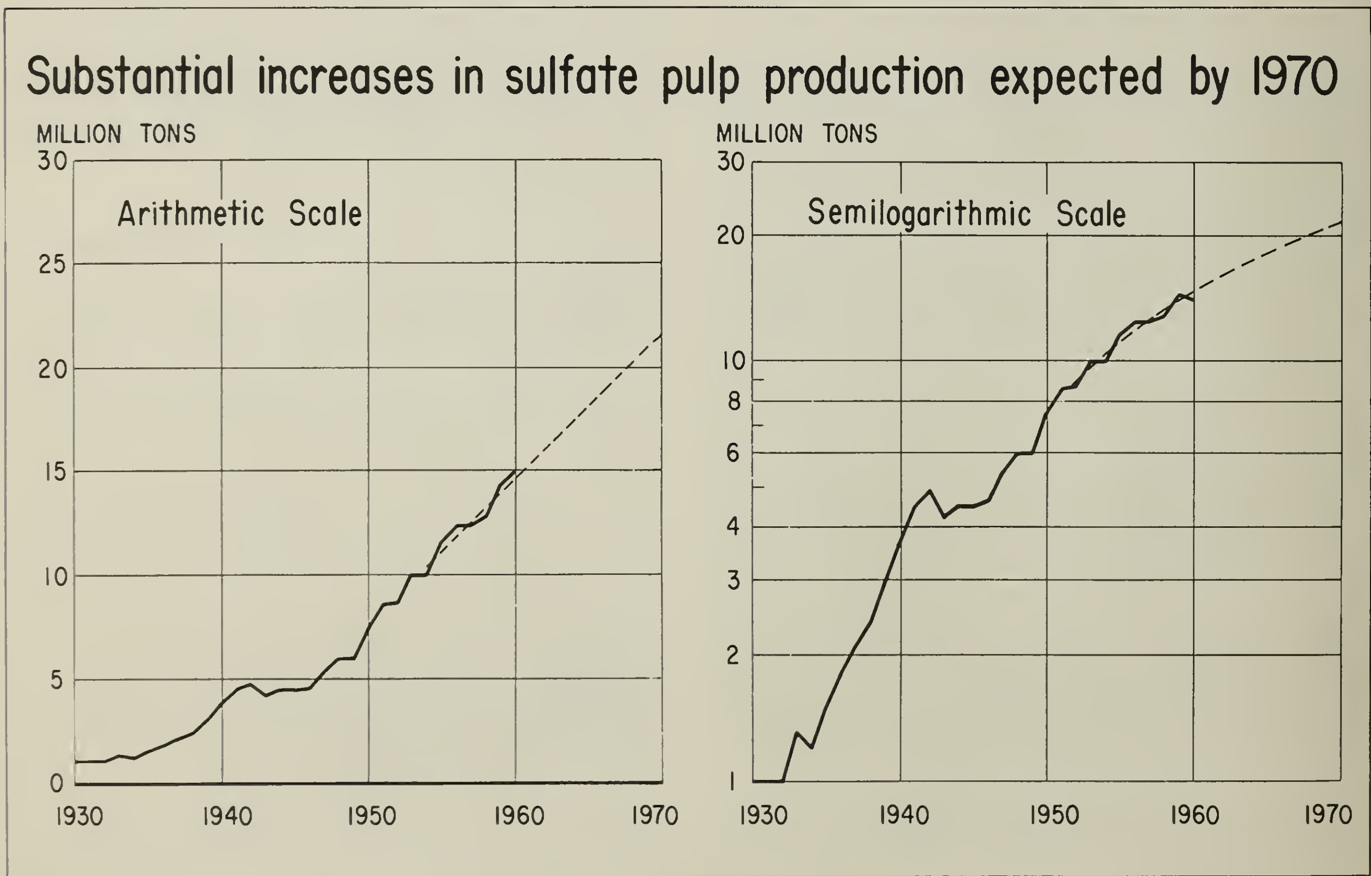

FIGURE 30

than round pulpwood, has increased even more rapidly. Chipped residues were not used in the South prior to 1953, whereas in 1960 they amounted to 13 percent of all wood consumed by pulpmills in the 12 Southern States (*9*).

Future expansion in the use of hardwoods and chipped residues in the South will likely be at much slower rates. The softwood pulpwood resource has increased in recent years, as a result of improved fire control, forest management, and planting, and softwoods generally are preferred over hardwoods. The best sources of chipped softwood residues now supply the 3 million cords used annually. Use of an appreciable portion of the remaining 1½ million cords believed available with the current level of lumber production will generally involve procurement from more scattered locations with smaller concentrations and, thus, higher costs.

Chipping of pulpwood in the woods as a means of reducing transportation costs, or wood storage at mills as chips rather than bolts also would lower yields of tall oil per ton of pulp. Chipping in the woods is unlikely to become very widespread in the immediate future. Definite benefits can be gained through chip storage at mills, and this practice is expected to become more common at new plants, and as wornout wood-handling equipment at older plants is replaced by chip-handling equipment.

Considering all above factors, we assumed that by 1970 about 56 pounds of tall oil and 1.3 gallons of sulfate turpentine will be recovered per ton of sulfate pulp produced nationally. Thus, potential output from 21.5 million tons of sulfate pulp could amount to 1.2 billion pounds of tall oil and 28 million gallons, or 560,000 barrels, of sulfate turpentine. Assuming that 90 percent of all tall oil recovered is fractionated and that 35 percent by weight of this is isolated as rosin, the production potential of the United States in 1970 is about 380 million pounds or 730,000 drums of tall oil rosin. As indicated in figure 31, this potential production capability is about 75 percent greater than the 420,000 drums of tall oil rosin and the 323,000 barrels of sulfate turpentine produced in 1960.

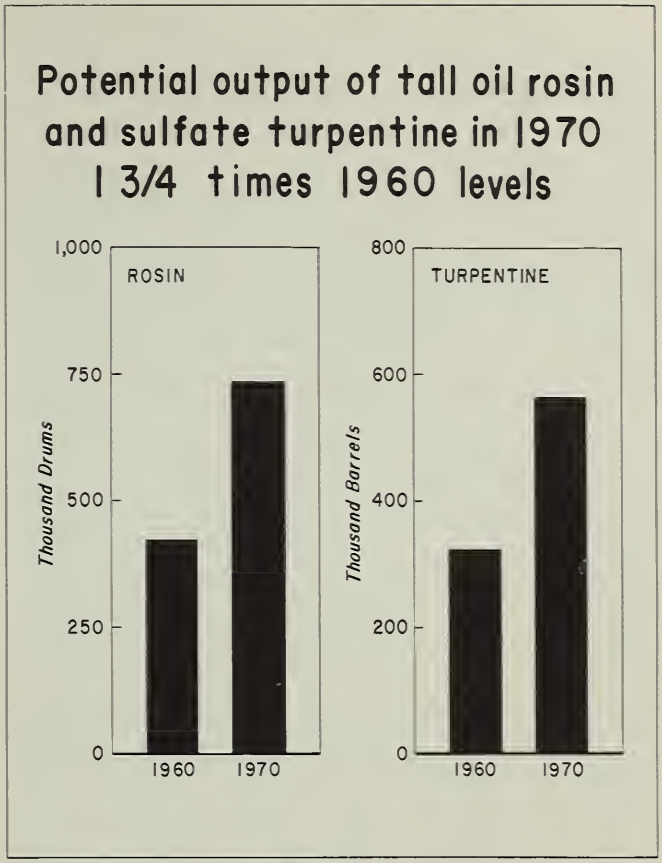

Figure 31

Total Domestic Production Capability—2½ Times 1960 Output

The U.S. naval stores industry apparently could produce 5 million drums of rosin and 1.6 million barrels of turpentine annually during the next 20 years—a maximum production potential about 2½ times 1960 output (fig. 32). This is the potential indicated by the sum of the estimates developed above for each of the three segments of our naval stores industry. What part of this productive potential will be realized during the years ahead depends upon future markets. We next consider, therefore, potential demands for U.S. naval stores.

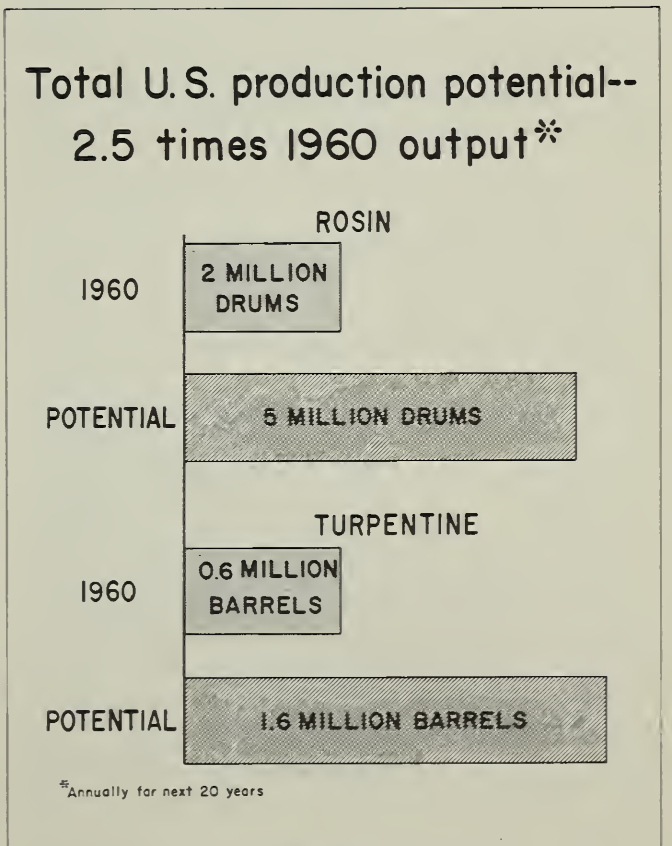

Figure 32

DOMESTIC CONSUMPTION AND POTENTIAL DEMAND

Consumption of Rosin in the United States Has Been Slowly Increasing

Rosin is a versatile chemical used by a large variety of industries for many years. U.S. consumption since 1930 has increased about 2 percent per year, with peak annual use about 1,550,000 drums (520 pounds net) in 1944, 1950, and 1959 (fig. 33 and table 15). Most of this growth occurred in the first 11 years of the 1930-to-1960 period. The rate of increase from the immediate postwar period (1946–48) to the 1959–61 period has averaged about 1 percent per year.

In recent years, increasing demands for rosin by the paper and "chemicals and pharmaceuticals" industries has offset by a small margin losses in demand by most other rosin-consuming industries (fig. 34). The paper and "chemicals and pharmaceuticals" industries consumed three-fourths of all rosin used in the United States during the past 5 years.

Estimates of Domestic Consumption and Future Demand Are Based on Data From Various Sources

Historical data available on domestic consumption of naval stores and demand-price relationships for most major end uses are not suitable for detailed statistical analyses and projections. Estimates of current consumption by major categories, therefore, were based on data published by the Statistical Reporting Service, supplemented by estimates for specific end uses obtained by interviews with major consumers of naval stores. Projections of domestic demand in 1970 were based on appraisals by Government and industry specialists of the outlook for specific end uses, with an assumed price for rosin of $11.50 per 100 pounds net in drums, basis WG grade, and for turpentine of $0.20 to $0.25 per gallon bulk at processing plants (constant 1961 dollar basis).

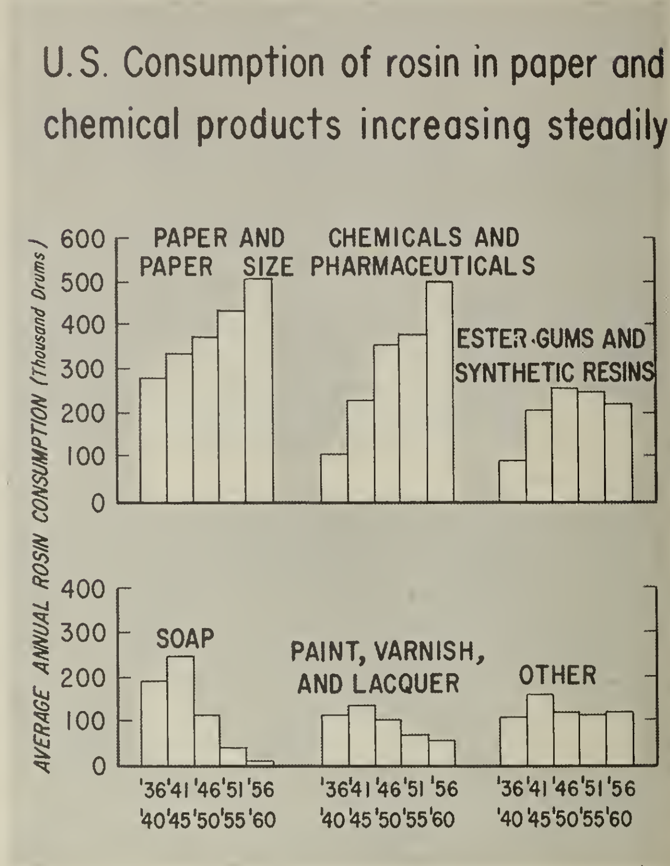

FIGURE 34

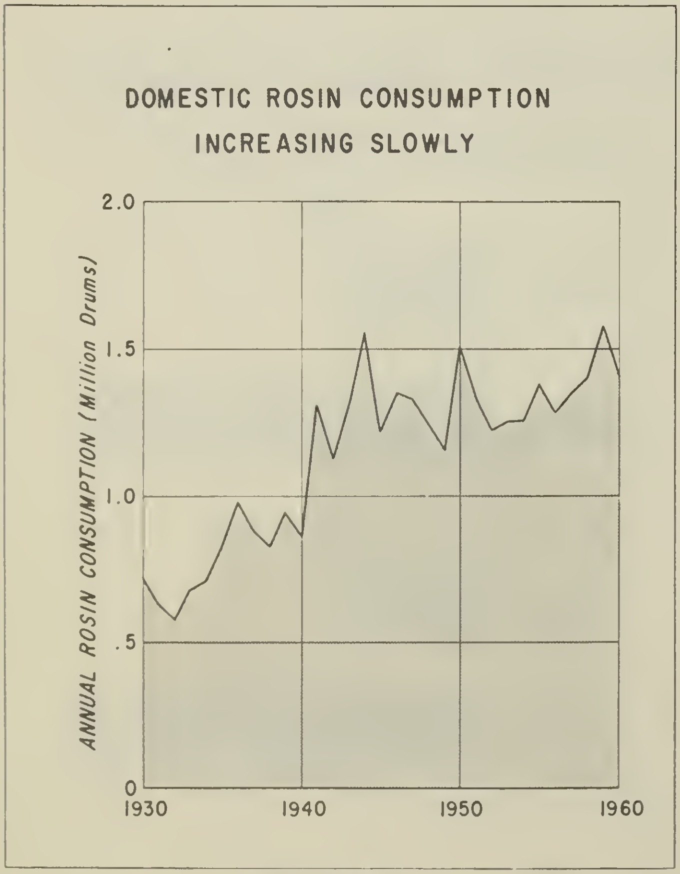

FIGURE 33

Rosin Consumption Trends Vary Among Uses

Chemicals and pharmaceuticals.—Some 546,000 drums of rosin, 39 percent of total domestic consumption, was used in 1960 by the "chemicals and pharmaceuticals" industries. This category is made up of several different industries using modified rosins, which tends to mask actual consumption of rosin in specific end uses. Estimates of modified rosin consumption in 1960 by end uses included in the overall category, and consumption of unmodified rosins by some of these

same end uses and others, are summarized in table 18.

According to trade sources the largest of the "chemicals and pharmaceuticals" uses in 1960 was in various types of adhesives, including those used for pressure-sensitive tapes, and as tackifying agents in latex, solvent rubber, and hot melt adhesives (100,000–150,000 drums); emulsion polymerization of rubber (125,000–175,000 drums); and printing ink (50,000–75,000 drums). Consumption of B-wood resin is included in the "chemicals and pharmaceuticals" category, except for the quantity consumed for paper size. B-wood resin, dark in color, is a fraction obtained in the refining process of wood rosins. It is used where lightness of color is not important, such as in dark papers, asphalt additives, dehairing compounds, sealing waxes, and waterproofing agents. The anticipated decline in the production of steam distilled wood rosin will, of course, result in a reduction in the availability of B-wood resin. Technological changes in processing techniques are already accelerating this trend.

Future demands for rosin by major end uses, including those within the "chemicals and pharmaceuticals" category, are discussed in detail below.

Paper size.—By far the largest single use of rosin in the United States is in paper size. Paper size is used in papermaking to impart resistance to penetration by liquids. Rosin size is added internally to the pulp in the beaters. Starch sizes also are used internally, as well as externally for closing surface pores. Almost one-third of all rosin consumed in 1960, some 480,000 drums, was used for paper size.

Rosin must compete with other materials for paper size markets. At the 1961 price of about 12 cents per pound, however, rosin appears to have little competition, except for specialty uses. One firm, for example, is marketing a fatty acid diketene at $1 per pound; another, a synthetic waxlike polyfunctional amine at approximately 45 cents per pound. Although only about one-seventh as much size is required using the fatty acid diketene, its price is too high to compete with rosin size for ordinary uses. Furthermore, rosin size apparently is preferred for most types of paper. The diketene is particularly useful for sizing under nonacidic conditions. Slightly alkaline conditions tend to prolong the life of cellulose.

Another synthetic size material is a resin derived from petroleum olefins. The resin for this size is now sold at 11 to 12 cents per pound and is required for sizing in percentages similar to those for rosin. If the price of rosin increases to about 15 cents per pound, it seems likely that the petroleum-based sizes would encroach significantly on rosin in paper size markets. In addition, size formulations developed from other raw materials during 1960, when rosin prices reached 15 to 18 cents per pound, would probably be reconsidered as rosin substitutes.

Rosin is also used for paper size in the form of stabilized rosin, or of maleic or fumaric acid-treated rosins. Stabilized rosin is used for specialty papers where yellowing due to aging of the size is undesirable. Modification of rosin through use of maleic or fumaric acid improves the efficiency of rosin in paper size and permits a reduction of about 25 percent in amount of rosin per unit of paper treated. This reduction in the amount of rosin required per unit of paper sized has largely been offset in recent years by increased use of sizing in papers which formerly were not sized.

Such "fortified" size is now used for about 80 percent of the papers in which this type of size is suitable, and the trend to such sizes is continuing, although leveling off. After the transition from unmodified size to fortified size is complete, the growth in rosin consumption by the paper industry will probably again be directly related to growth of the paper industry, or 3 percent per year. By 1970, use of rosin for paper size is expected to approximate 655,000 drums annually.

Rubber.—Rosin and rosin derivatives have long been used in the compounding of natural rubber, primarily as a processing aid and extender. Rosin has also become important as an emulsifier in synthetic rubber manufacture. For this purpose stabilized rosin soaps are used with fatty acid soaps, from various sources depending on raw material prices. Especially processed tall oil is the principal competing material for this end use. Most rosin used for emulsification remains in the synthetic rubber and also performs as a processing aid. However, some additional rosin may also be needed for this latter purpose. Synthetic resins and mineral oil also are used as rubber processing aids in competition with rosin.

A typical emulsifier for styrene butadiene rubber (SBR) contains about equal amounts of the sodium or potassium soaps of disproportionated rosin and fatty acids. Specially treated or refined tall oil, which is about one-half rosin and one-half fatty acid, also is used as an emulsifier in competition with the rosin-fatty acid soap emulsifiers. Total emulsifier required for synthetic rubber (SBR) is about 6½ percent of the weight of the finished rubber, on a solids basis, and in 1960 totaled 1,166,151 long tons (*23*). Rosin comprises slightly less than half the emulsifier, or about 3 percent of the finished rubber, when allowance is made for the potassium or sodium content of the rosin soap. Based on this percentage and 1960 rubber production, an estimated 125,000–175,000 drums [5] of rosin was consumed in 1960 as emulsifiers. Production of SBR rubber is expected to level off in 1962 at about 1.2 million long tons. Furthermore, recent commercialization of stereo synthetic rubber and increased uses

[5] Including the rosin fraction of distilled or refined tall oil.

of butyl rubber, in which no emulsifier is required, are expected to encroach on markets for traditional synthetic rubbers and natural rubber. Considering all factors, consumption of rosin for emulsion polymerization of synthetic rubber is expected to increase slightly to 130,000–180,000 drums [5] annually by 1970.

Additional rosin is used by the rubber industry as a tackifier in the form of hydrogenated rosin and rosin esters as well as unmodified rosins. Competition from coal tars and petroleum-derived resins for this market is increasing. In addition, rubber in which mineral oil is used as an extender requires less tackifier. In 1960 an estimated 15,000–25,000 drums of rosin was used for rubber tackifying adhesives. Primarily because of competition from lower cost petroleum polymer resins, consumption of rosin for this purpose is expected to decline slightly to 10,000–20,000 drums annually by 1970.

Surface coatings.—Rosin consumption for protective coatings has been declining slowly for many years (fig. 34 and table 15; see categories "paint, varnish, and lacquer" and "ester gums and synthetic resins"). This has been due primarily to the development of synthetic polymers not requiring resin modification and to the replacement of rosin by distilled or refined tall oil as a resin modifier.

Various types of rosin and modified rosins, such as hydrogenated or otherwise stabilized, are used to prepare esters of methanol, glycols, glycerol, and pentaerythritol for the manufacture of protective coatings and printing inks. Rosin-modified alkyd resins and rosin-modified resins of the maleic-anydride-glycerol or pentaerythritol types also are used in protective coatings. Although rosin is preferred in some types of coatings for its depth of color and good adhesive qualities, synthetics are encroaching on this market because of lower cost. This competition will probably increase, and no research approach is visible which might lead to counteracting this downward trend. Outlets for rosin and rosin derivatives in the various surface-coating formulations are expected to decline about 15 percent by 1970 (table 18).

Adhesives.—Rosin and stabilized rosins and esters are being used in increasing quantities in various types of adhesives including pressure sensitive tapes and in latex, rubber, and hot melt adhesives. In most applications for pressure-sensitive tapes, the selection of the particular type of rosin (wood, gum, tall oil) is very specific. For instance, stabilized rosins such as hydrogenated rosin and dehydrogenated rosin and derivatives, all of which are used in pressure-sensitive tapes, are not always interchangeable in a given application. In cases where rosin is used as a building block, tall oil rosin does not perform satisfactorily. Presumably, small amounts of fatty acid in the tall oil rosin interfere with the adhesive characteristics. Primary competitors of rosin in adhesives are petroleum and coumarone-indene derived resins.

Consumption of rosins and rosin derivatives in pressure-sensitive tapes for pharmaceutical, industrial, and defense uses totaled about 9,600 drums in 1960. This use is expected to increase about 8 to 10 percent per year over the next 10 years. In view of the special properties that various rosin products contribute, serious competition in this use from other materials is unlikely, even if rosin prices reach 14 to 15 cents per pound. However, users are continuously seeking substitutes. Another naval stores product used as an adhesive for such tapes is a resin derived from the beta-pinene fraction of turpentine. This, however, is used in formulations where rosin materials cannot be substituted.

Total domestic consumption of rosin in 1960 for all types of adhesives combined is estimated at 140,000–200,000 drums,[6] and this use is expected to increase to 200,000–265,000 drums annually by 1970. (See adhesives and plastics, tackifying resins and tackifying adhesives, table 18.)

Printing inks.—Rosin-modified phenolics and rosin-modified maleic glycerol or pentaerythritol esters have lost ground in printing inks and have been replaced by calcium and zinc salts of rosin. The competition from petroleum and coumarone-indene resins is strong and increasing. While some specialty inks, such as steam-setting inks, require rosin-derived esters because of their needed solubility in glycols, overall it appears that rosin will continue to lose ground in the ink field. Use of rosin in printing inks during the 1960's is expected to shrink percentagewise compared to competing materials, but remain at 70,000–90,000 drums annually because of overall growth of the use of inks (table 18).

Chewing gum.—From 25,000 to 35,000 drums of rosin derivatives were used during 1960 in chewing gum. Here, rosin derivatives are used as extenders for the more expensive imported chicle. This market is expected to expand with increases in population to 30,000–40,000 drums annually by 1970.

Oils and greases.—Consumption of rosin in oils and greases declined sharply after World War II, fluctuated between 13,000 and 20,000 drums annually during the following decade and, since 1957, has remained at about 10,000 drums. Rosin soaps used in cutting oils are expected to be further replaced by more efficient synthetic emulsifiers with demand for rosin continuing downward to about 7,000 drums by 1970.

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[6] Hegeman, George B., and Heeley, William A. The Naval Stores Industry. Unpublished report for Arthur D. Little, Inc., and National Rosin Oil Products, Inc. 1961.

Other uses.—There are a substantial number of miscellaneous other uses for rosin, particularly B-wood resin, most of which amount to less than 4,000 drums annually. These include corrosion inhibitors, asphalt additives, dry battery seals, can sealers, binders for dolls' heads and poker chips, calking compounds, dehairing compounds, dental waxes, floor polish, flypaper, leather compounds, matches, metal cleaners, petroleum production and processing chemicals, pigments, solder flux, waterproofing agents, and violin bows.

Rosin requirements for many of these end uses are expected to decline primarily because of competition from substitutes which provide lower costs and/or better properties. In a few cases, declines in markets for finished rosin-containing products account for the waning rosin demand by some industries.

Domestic Demands for Rosin Up 14 Percent by 1970

Combining all the above divergent trends, total domestic rosin consumption is projected from 1,408,800 drums in 1960 to about 1,606,000 drums in 1970 (fig. 35), an increase of about 14 percent. This essentially is a continuation of the postwar trend.

Domestic Consumption of Turpentine Has Increased Slowly With Major Shifts in Uses

Domestic consumption of turpentine has increased an average of about 2 percent per year since 1930. Consumption increased steadily throughout the 1930's, remained below 500,000 barrels annually during World War II, then increased to an alltime peak of 594,000 barrels in 1950. Since 1950, domestic consumption has remained relatively constant and averaged about 550,000 barrels (50 gallons) per year (fig. 36 and table 17).

Total domestic consumption of turpentine can be divided into two major categories: industrial consumption and retail sales. Since 1950, the consumption pattern has shifted greatly between these two outlets. Prior to about 1950, three-fourths of all turpentine consumed in the United States was distributed through retail outlets for use as a solvent or thinner for paints and varnishes. Since then, competition from water-miscible paints and low-cost petroleum solvents has caused a continuous decline in retail sales. Currently this outlet represents about one-fourth of

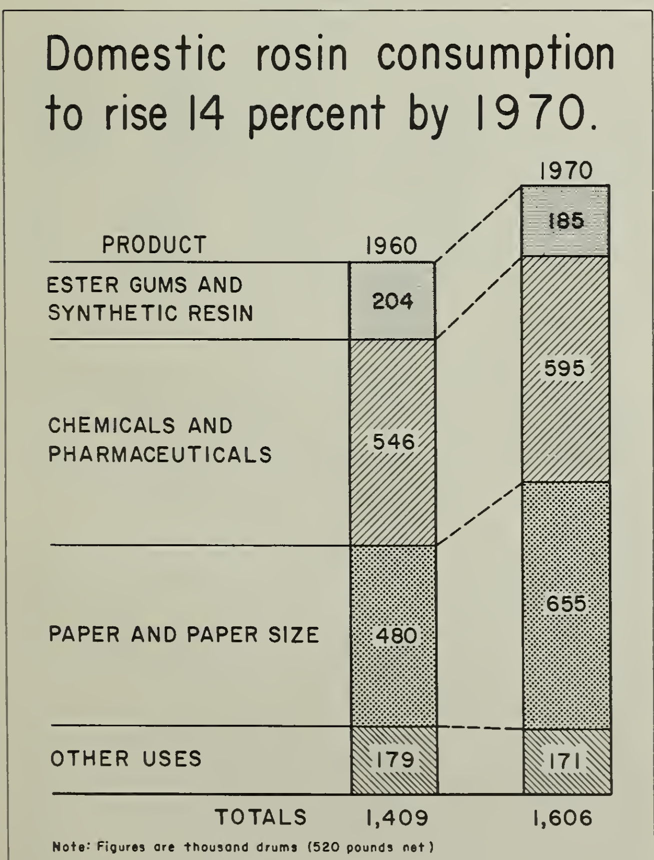

FIGURE 35

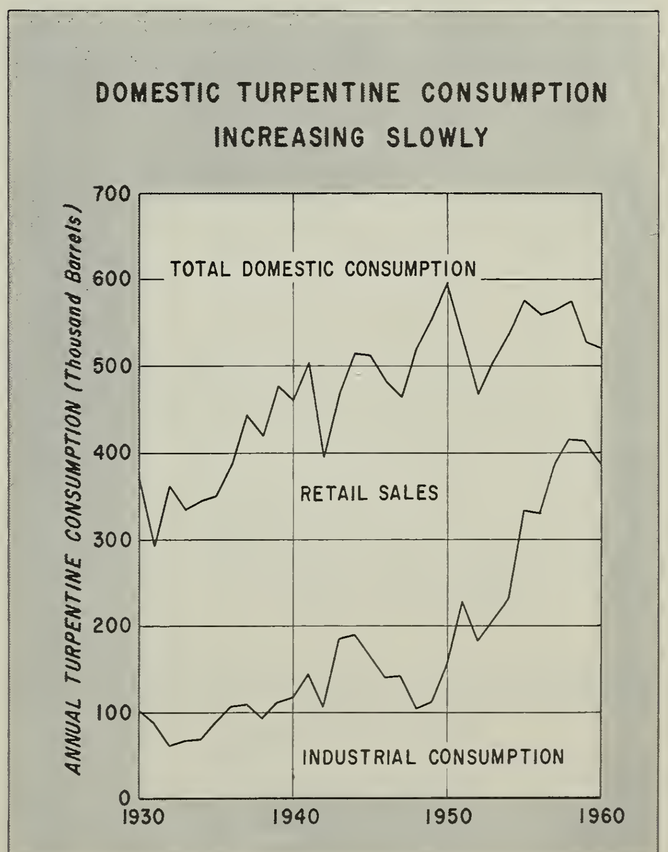

FIGURE 36

our domestic consumption of turpentine and, in 1960, totaled 146,000 barrels.

The decline in retail sales of turpentine during the past decade has been more than offset by increases in industrial consumption. Since 1950, industrial consumption has increased from 152,836 barrels to 376,770 in 1960, an average annual increase of about 10 percent (tables 16 and 17).

Most Turpentine Now Used for Chemical Products

Domestic consumption of turpentine for chemical products has been increasing rapidly, as shown in figure 37. Chemical products included in the overall category "chemicals and pharmaceuticals" accounted for 71 percent of all domestic consumption in 1960. Other industrial uses such as paint, varnish, and lacquer, shoe polish, and foundry supplies, which once were important, have declined to where they now represent less than 2 percent of domestic turpentine consumption (table 19).

Some industries use whole turpentine, but most consume various turpentine fractions including primarily alpha-pinene, beta-pinene, dipentene and other monocyclic terpenes. The percentages of whole turpentine consisting of these different components varies among the three types of turpentine as follows:

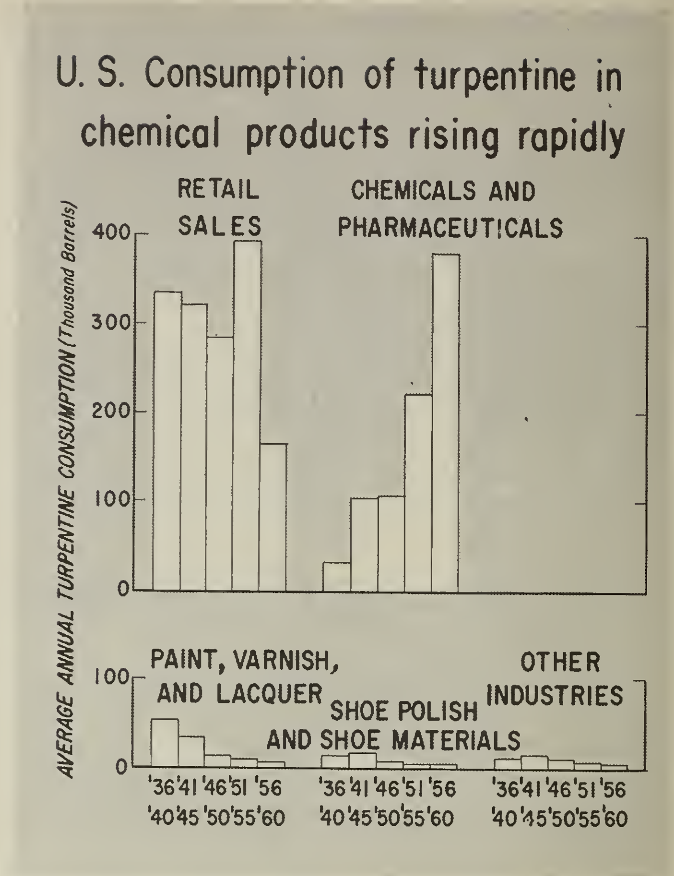

FIGURE 37

Component	*Gum turpentine (percent)*	*S-D wood turpentine (percent)*	*Refined sulfate turpentine (percent)*	*Crude sulfate turpentine (percent)*
Alpha-pinene	60–65	75–80	60–65	50–65
Beta-pinene	25–35	0–2	25–30	20–30
Dipentene and other monocyclic terpenes	5–8	15–20	5–7	16–18
Camphene	--------	4–8	0–2	0–2
Total	100	100	100	100

The components of turpentine are separated by fractional distillation. Alpha-pinene is the principal component of all types of turpentine while beta-pinene is present only in gum and sulfate turpentines. Dipentene and related products are most abundant in steam distilled wood turpentine. Because of this variation in composition, the several turpentines are not entirely interchangeable, particularly for chemical uses.

Potential Demands for Turpentine Vary Among Uses

Domestic turpentine requirements for production of all products combined in the "chemicals and pharmaceuticals" category are expected to increase from 369,545 barrels in 1960 to 430,000 barrels in 1970, an increase of about 16 percent (table 19).

Alpha-pinene requirements are projected from 215,000 barrels in 1960 to 245,000 barrels in 1970, an increase of 14 percent (fig. 38). The major products made from alpha-pinene are synthetic pine oil, insecticides, and lubricating oil additives.

Synthetic pine oil is used principally in disinfectants, soaps, and cleaners. Important amounts are consumed in a number of miscellaneous uses by the textile industry, in ore flotation, and in deodorants. There are two types of pine oil: synthetic and "natural." The former is produced from alpha-pinene or whole turpentine, while "natural" pine oil is a byproduct of the wood rosin extraction process. These products have essentially the same properties, with the exception that synthetic pine oil does not have as pleasing an odor to many consumers as natural oil. Natural pine oil often is blended with synthetic pine oil designed for the consumer market to minimize the odor difference.

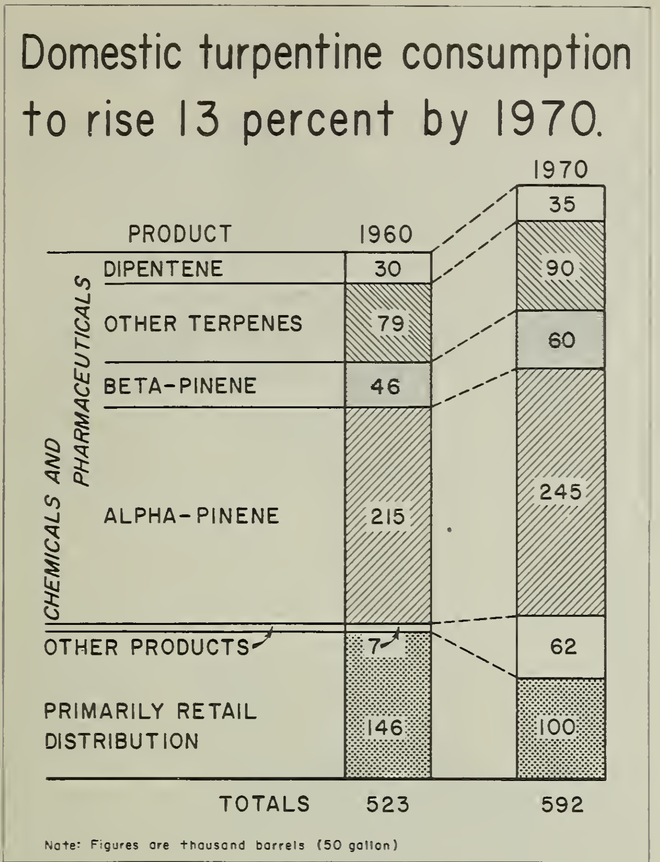

FIGURE 38

Use of pine oil in cleaners and disinfectants recently declined somewhat because of shortages of pine oil and competition from lower priced, well-advertized, synthetic detergents produced from petroleum derivatives. Synthetic pine oil, presently in excess supply, probably will face increased competition from lower priced cleaners and disinfectants. Increased pine oil advertising by the industry, however, may counteract this competition.

Looking ahead, all available "natural" pine oil probably can be sold at satisfactory price because of its desirable odor properties and the reduced supply anticipated with a decline in steam distilled wood rosin production. A reduction in supplies of "natural" pine oil probably will increase demands for synthetic pine oil. Synthetic pine oil requirements for uses in which odor properties are unimportant are expected to increase somewhat. Overall, domestic demands for synthetic pine oil is projected from 100,000 barrels (turpentine equivalent) in 1960 to 120,000 barrels in 1970, an increase of 20 percent.

Insecticides made from alpha-pinene, which has been isomerized to camphene and then chlorinated, are used to control the cotton boll weevil, army worm, and other pests. Another outlet for alpha-pinene is lubricating oil additives, prepared by interacting phosphorous pentasulfide with terpenes. Such additives are gradually being replaced by other synthetics because of changes in technological requirements. Consumption of alpha-pinene for insecticides, lubricating oil additives, and other minor uses such as synthetic camphor and menthol is expected to increase from 115,000 barrels (turpentine equivalent) in 1960 to about 125,000 barrels in 1970.

Beta-pinene requirements for resins are projected from 46,000 barrels in 1960 to 60,000 barrels in 1970, an increase of about 30 percent. These resins are widely used in pressure-sensitive tapes. They also process well with rubber and with hydrocarbons such as polyolefins for paper coatings.

Competing products, which are encouraged by current shortages of beta-pinene, include a copolymer of styrene homologer and a resin from petroleum olefins. Each is cheaper than the terpene resin, and supplies of raw materials from which they are derived are essentially unlimited. Additional future competition is likely from an isoprene from petroleum, the dimer of which can be converted to a resin with properties similar to those of terpene resins. For tapes, however, the adhesive made from beta-pinene provides a response to very slight pressure that cannot be equaled by competing products.

Current consumption of beta-pinene for resins is estimated to be 46,000 barrels (turpentine equivalent). Consumption probably would double this in a short time if sufficient beta-pinene was available at or slightly below current prices. Consumption is projected to 60.000 barrels likely to be required in 1970.

"*Dipentene*" is used primarily as a solvent in the reclaiming of rubber. It is well entrenched in this field and has a small growth trend. Demand for dipentene is expected to increase from 30,000 barrels consumed in 1960 to 35,000 barrels in 1970.

Whole turpentine is consumed by several other industries for products such as paint, varnish, and lacquer, oils and greases, and rubber. These minor outlets for turpentine totaled about 7,200 barrels in 1960 and generally are declining. Potential industrial demand for all uses of whole turpentine other than adhesives and plastics will likely decline to about 2,000 barrels annually by 1970 (table 21). Recent developments in the manufacture of resins from whole turpentine, for use in adhesives and plastics, indicates a promising new outlet for turpentine which could reach 60,000 barrels annually by 1970.

Potential Domestic Demand for Turpentine—Up 13 Percent by 1970

Combining estimates of potential retail sales and industrial requirements, potential domestic demand for turpentine is projected from 522,770 barrels in 1960 to 592,000 barrels in 1970, an increase of 13 percent (fig. 38).

This estimate of potential domestic demand for turpentine could well prove too conservative. If turpentine prices remain near the current low levels, which appears likely with a surplus of 160,000 barrels anticipated (page 55), new and expanded uses beyond those discussed are likely to be developed.

FOREIGN PRODUCTION AND CONSUMPTION, AND THE EXPORT MARKET FOR U.S. NAVAL STORES

This section describes world production trends, the level of world stocks and overall supplies, and trends in world trade and consumption. An estimate of the potential U.S. export market for naval stores in 1970 is developed as the difference between projected foreign production and consumption.

World Production of Naval Stores Increasing

World naval stores production since the end of World War II has varied in response to such diverse factors as weather conditions, price levels, alternative utilization of forest and labor resources, and currency problems. Overall, output has increased, not as rapidly as expanding industrial activity, but approximately in line with increased demand for naval stores.

World naval stores production, both United States and foreign, increased about one-fifth during the 5 years immediately prior to World War II. World War II disrupted naval stores production, particularly in the United States, Greece, France, the U.S.S.R., and Poland. The low point was reached in 1944 when world output was more than one-third below the 1938 level. Thereafter, world production rose steadily to a peak in 1951. During this period (1944–51) foreign rosin and turpentine output rose 73 and 69 percent, respectively, reflecting spectacular expansion in the U.S.S.R. and China as well as significant increases in France, Portugal, and Greece. The rise in U.S. output (65 percent for rosin and 51 percent for turpentine) was not quite as steep and culminated in 1950 rather than 1951. World production declined during the readjustment years 1952 and 1953, then resumed its upward trend. Increasing foreign output is largely responsible for this trend, since U.S. production rose only slightly between 1954 and 1961. Foreign rosin and turpentine output since 1954, stimulated by increased rosin demand which culminated in the record high prices of 1960, spurted 77 and 68 percent, respectively (fig. 39). Foreign output rose markedly in all major producing countries except France.

Production by principal countries is shown in table 22. Here it should be noted that data from the Sino-Soviet bloc are estimates, based partially on production goals, changes in volume of foreign trade, and, for some years, derived from volume of crude pine gum output.

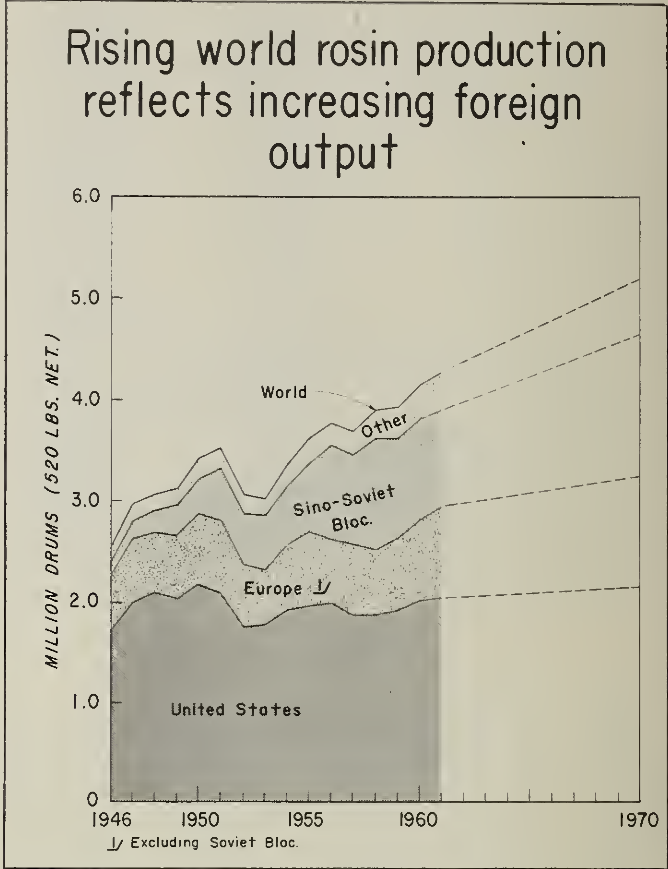

Figure 39

Data on crude tall oil covers only the United States, Scandinavia, and Japan. In addition, Austria, Canada, China, France, Poland, Portugal, and the U.S.S.R., among others, also are producing tall oil. French output has averaged about 1,400 short tons during the past 3 years, and Portuguese production less than 400 tons. No information is currently available on the extent of Russian production, but Russia's potential is considerable. Canadian production is small and could be increased by additional recovery of tall oil at existing sulfate pulpmills. Actual Canadian output is not available for publication because of the few firms involved and the consequent risk of disclosure of individual operations. Fragmentary information on Poland, Austria, and China is available mostly through import statistics of other countries. West Germany imported nearly 1,600 short tons of tall oil from Poland and 600 from Austria during 1960. Switzerland imported

400 tons from Austria, while Australia received over 300 tons from China.

United States Is World's Leading Producer of Naval Stores

The United States produces almost as much rosin and turpentine as the rest of the world combined. Although the volume of U.S. naval stores production as a whole has not changed significantly since the end of World War II, the U.S. share of expanding world output has been declining. U.S. rosin output, which averaged two-thirds of world production during the postwar years 1946–50, represented 48 percent of world output in 1961. During the same period, the U.S. share of world turpentine production declined from 60 to 43 percent. U.S. turpentine and, to a lesser extent, rosin production are expected to increase in the decade of the sixties. However, the U.S. share of world rosin production probably will continue downward to about 41 percent by 1970. On the other hand, the U.S. share in world turpentine output in 1970 is likely to remain about 43 percent.

The United States produces about three-fourths of the world's output of crude tall oil, exclusive of the Sino-Soviet bloc. Anticipated trends in sulfate pulp output in the United States and abroad indicate that the United States will continue to produce close to three-fourths of the free world's supply of crude tall oil.

About three-fourths of foreign naval stores production in 1961 originated in Europe (fig. 40). Exclusive of Communist-bloc countries, Europe accounted for about 21 and 28 percent of the world's rosin and turpentine production, respectively. The Sino-Soviet bloc is estimated to have produced slightly over one-fifth of the world's naval stores in 1961.

The U.S.S.R. produced about 14 percent of world rosin output in 1961, followed in descending order of productivity by Portugal with 7.5 percent; China, 6 percent; Mexico and France, 4.5 percent each; Spain, 4 percent; Greece, 3 percent; and India and Poland, 2 percent each.

The pattern of foreign turpentine production was similar, the U.S.S.R. leading with 12 percent of world output; Portugal, 7 percent; China, 6 percent; France and Spain, 5 percent each; Sweden and Mexico, 4 percent each; Greece and Finland, about 3 percent each; and Poland and India, 2 percent each.

Lower World Production Likely in 1962

World production in 1962 is expected to be about 3 percent lower than for the previous year, unless sharply curtailed output in Western Europe is offset by a greater than expected increase in Sino-Soviet-bloc production. Slightly lower U.S. rosin production is anticipated in 1962 with a likely 6-percent reduction in steam-distilled wood rosin output more than offsetting a 5-percent rise in gum rosin production and a 4-percent increase in the output of tall oil rosin. Not much change is expected in U.S. turpentine production.

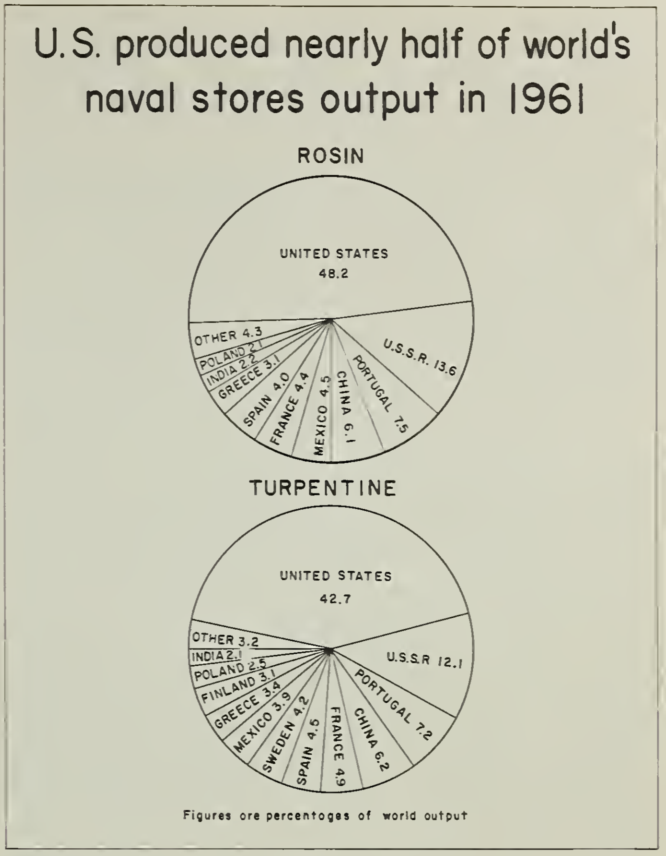

FIGURE 40

European production in 1962, exclusive of Communist-bloc countries, is expected to be down nearly one-fifth because of reduced output in Portugal, Spain, France, and Greece. The steepest reduction—nearly one-third down from the 1961 level—is expected in Portugal. France intended to maintain its 1961 output level, but adverse early season weather may reduce the crop. Overall, European production in 1962, as compared with 1961, may be down about 150,000 drums of rosin and 50,000 barrels of turpentine. However, the reduced rosin output will be more than offset by a 253,000-drum increase in stocks of European producing countries on January 1, 1962, as compared with a year earlier. Moreover, based on Western European imports of naval stores from Sino-Soviet sources during January and February 1962, as compared with the same period last year, it may be that production or, more specifically, export availabilities from these sources may increase in 1962. This is in line with past tendencies toward political orientation of Sino-Soviet-bloc naval stores export trade. Actually, except for occasional sorties into western markets aimed in part at disrupting existing trade

patterns and aggravating the effects of short term supply-requirements discrepancies, naval stores requirements of the Communist countries over the long term are expected to absorb an increasing proportion of their output.

Tall oil production is expected to increase throughout the world. In the United States more complete coverage by the Bureau of the Census will give the unwarranted impression of a substantial increase in 1962 output over the 1961 level.

World's Timber Resources Sufficient for Substantial Increase in Gum Production

Availability of suitable timber is not a limiting factor in gum naval stores production. If all timber suitable for naval stores production were so used, world output could be increased many times over. However, because of limitations imposed in many areas by various production factors, the great bulk of this timber will not be used for naval stores production in the foreseeable future. Among the restrictive factors involved are alternative utilization of forest and labor resources, productivity of labor, availability of and competition for capital. demand for naval stores, difficult terrain, lack of roads and technical knowledge, unsettled political conditions, and severe financial restrictions on foreign operations in some underdeveloped areas.

Timber potentially adaptable to naval stores production is widespread. In the Western Hemisphere, the United States, Canada, Mexico, Central America, and, to a far lesser extent, Chile, Surinam, and Cuba, have the greatest potential, timberwise, for additional naval stores production.

In Europe outside the Iron Curtain, Spain, Greece, and the Scandinavian countries appear to be capable of substantially increased production. Pine forests in Spain are known to be the most extensive in Western Europe. To a lesser extent, forests in the Bordeaux region of France are capable of somewhat greater output, provided adequate labor is available. In this respect, mobility of labor within an expanded Common Market may increase French production in the 1960's by a maximum of 10 percent, at current naval stores price levels. Potentially affecting Western European production is the International Commission of Rosin Products being established in Western Europe for stabilization purposes and to promote development of production, processing, and marketing techniques. As of July 1962, this organization encompassed most of the production in Portugal, Spain, France, and Greece. Although this apparently is a long-term project, its ultimate fulfillment should tend to stabilize foreign production and trade.

Within the Sino-Soviet bloc, timber potential for expanded naval stores production is greatest in the U.S.S.R., whose enormous pine forest areas are about 70 times the size of their French counterparts. The great bulk of Russian pine stands, however, are Scotch pine—a relatively poor yielder of oleoresin. Following World War II, extensive pine forestation was conducted in Poland, which in the next decade will be capable of substantially increased production. As in the case of the U.S.S.R., however, Polish forests are comprised mainly of Scotch pine. Recent deforestation has reduced the potential for Chinese naval stores production, and output in the next decade is unlikely to surpass the peak level attained in 1958.

Elsewhere, timber suitable for considerable additional naval stores production is available in Turkey, India, and Pakistan, throughout Southeast Asia, and in Australia and New Zealand. Naval stores are not now produced in the latter two countries and any future output is likely to be confined to sulfate naval stores.

Foreign Sulfate Naval Stores Production Will Increase With Expansion of Sulfate Pulping

Europe outside the Communist bloc apparently is recovering most of the tall oil and sulfate turpentine economically recoverable with current output of sulfate pulp. In Sweden and Finland, yields of crude tall oil and sulfate turpentine have averaged about 53 pounds and 1⅓ gallons per ton of sulfate pulp produced during the 5-year period 1956–60. This approximates yields from total sulfate pulp output in the United States. As demand for paper and board increases, sulfate pulp production will rise, accompanied by expanded output of tall oil and sulfate turpentine.

Some countries produce significant quantities of sulfate pulp, but are not at this time substantial producers of tall oil and sulfate turpentine. A large part of the softwood raw material consumed by pulpmills in Canada and Japan, for example, consists of spruce and fir which are not rich in naval stores.

Assuming continuance of current tall oil and turpentine yields from pulp, foreign production of crude tall oil and sulfate turpentine are expected to increase about 80 percent by 1970 to about 200,000 short tons and barrels, respectively.

Expansion of Foreign "Stump Wood" Naval Stores Production To Continue

Production of steam-distilled wood naval stores, waning[7] in the United States, is expected to continue expanding abroad. However, except possibly in the U.S.S.R., this type of output could only supplement other sources during the current decade.

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[7] The expected decrease in U.S. wood rosin production in the sixties will be reflected in lower production of FF rosin. Output of further refined grades of wood rosin is likely to show relatively little change.

Accurate data on foreign production of steam-distilled wood naval stores are not available. Most countries lump both gum and steam-distilled output in their statistics. Outside the United States, the bulk of "stump wood" naval stores currently is produced in Communist-bloc countries (mainly U.S.S.R. and Poland) and Mexico.

Production in Latin America may treble by 1970, with production scheduled to start late in 1962 in British Honduras and the following year in Nicaragua. These two operations reportedly will have a combined annual output capacity of about 80,000 drums of rosin (FF basis) and about 15,000 barrels of turpentine. Preparations are being made to import and refine part of the rosin in the United States. Further expansion of this type of production is likely in Latin America as demand for rosin expands in that region.

Elsewhere, during the decade of the sixties, production of steam-distilled wood naval stores is expected to increase in Sino-Soviet bloc countries and probably will be initiated in India. The latter is striving to augment its gum naval stores production in order to meet increasing prospective rosin and turpentine requirements in the next decade.

Foreign Production Projected to 1970

Foreign rosin production in 1970 is projected to 3,060,000 drums, nearly 40 percent above the 1961 level. Over the same period, turpentine production is expected to increase by about one-third to about 1,135,000 barrels in 1970. As previously stated, an 80-percent increase is expected in crude tall oil production.

These forecasts are based on a country-by-country analysis of production potentialities and of post-World War II output trends, and a number of assumptions, including:

(*a*) Assumption that rosin prices in 1970 will approximate $11.50 per 100 pounds net in drums, basis WG grade, and turpentine prices of $0.20 to $0.25 per gallon bulk, at processing plants (constant 1961 dollar basis).

(*b*) Assumption that all major producing countries in Western Europe, except Finland, will be affiliated with the Common Market (EEC) by 1970, and that, in general, peacetime conditions will prevail.

Projections of production to 1970 by major countries or country groups are shown in figure 39 and table 21. Production of rosin in Europe outside the Iron Curtain is estimated at 1.1 million drums in 1970, an increase of about 203,000 drums, or 23 percent above 1961 production. Spain, Portugal, Greece, and the Scandinavian countries are likely to experience the greatest output expansion, accounting collectively for about 90 percent of the increase in this area.

In Scandinavian countries, increased rosin production assumes continuing installation of additional crude tall oil fractionating facilities. By 1970, these countries together may produce about 100,000 drums of rosin.

Spain has the greatest expansion potential in Western Europe. However, the extent to which this potential will be realized will depend in large part on incentives and on success in achieving Common Market affiliation. By 1970, Spain may produce approximately 250,000 drums of rosin.

The Greek naval stores industry is planning to modernize during the transition period of Greece's association with the EEC. If modernization is achieved in the next decade, Greek rosin production may increase by a maximum of one-third to perhaps 175,000 drums by 1970.

At the assumed price levels, Portuguese output by 1970 may exceed their record output of 1961.

Based mainly on post-World War II output trends, rosin production in the Sino-Soviet bloc is expected to reach 1.4 million drums in 1970, an increase of about 47 percent over estimated 1961 output and a growth rate of about 4 percent annually. Increase should be substantial in the U.S.S.R. and Poland. Chinese production may rise above the estimated 1961 level, but a recovery to the 1958 crop level is doubtful because of relatively recent deforestation. In 1958, during the small-scale steel plant vogue, nearby mountains were stripped for wood fuel. Timber industries, in order to meet their quotas, have hacked away indiscriminately without adequate reforestation measures.

Elsewhere, rosin production by 1970 is expected to increase an average of 56 percent above 1961 output. Production in Mexico, stimulated by growing requirements and favorable trade conditions within the Latin American Free Trade Area (LAFTA), is likely to continue its growth, reaching 240,000 drums in 1970. Greatly expanded output is expected in Central America and Turkey, with production in 1970 totaling 65,000 and 40,000 drums, respectively. India, envisioning substantially increased domestic requirements, may increase production by nearly 60 percent to about 150,000 drums. Under peaceful conditions, the small production in Southeast Asia may be expanded to perhaps 40,000 drums by 1970.

At the assumed price levels, turpentine production in 1970 will depend primarily on the demand for rosin and kraft paper. The one-third increase forecast in turpentine production for 1970 compared with 1961 is apt to be well distributed. Output is expected to expand about 20 percent in Western Europe, including Scandinavia and Greece; about 47 percent in the Sino-Soviet bloc; and about 40 percent elsewhere (Latin America, India, Turkey, Pakistan, Southeast Asia, and Japan). Overall, foreign turpentine production is forecast to increase by about 281,000 barrels (fig. 41 and table 21). As in the case of rosin, this increase is expected to be accompanied by expanded foreign requirements, subsequently discussed.

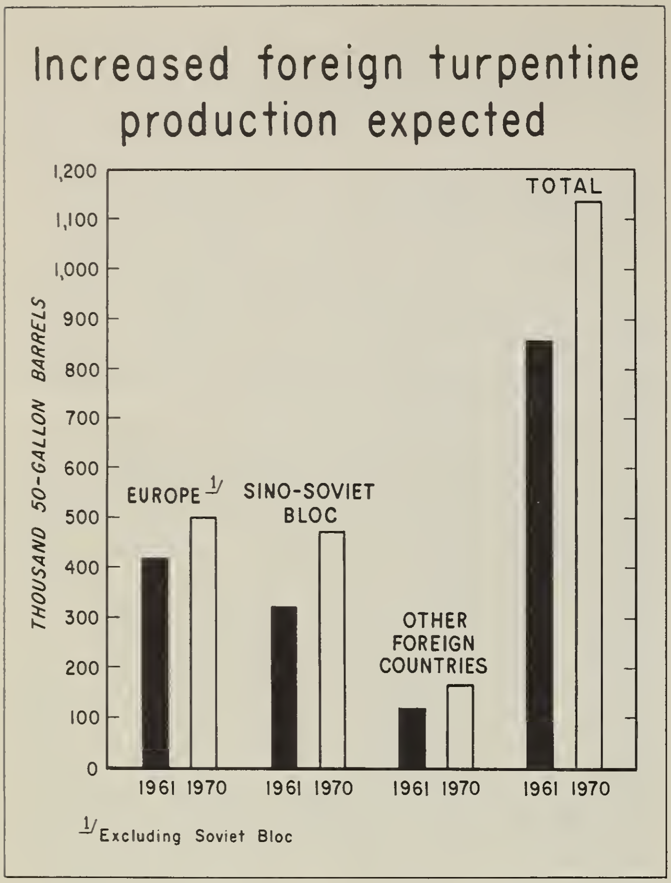


FIGURE 41

Rosin Stocks of Foreign Producing Countries Now Greatest Since World War II

Three developments stand out in the 1962 inventory situation. First, foreign producing countries, spearheaded by Portugal, are carrying the largest stocks on record since World War II.[8] Stocks in foreign producing countries outside the Sino-Soviet bloc are nearly one-quarter million drums, or more than 2½ times the total a year ago. Portuguese stocks comprise more than half of this inventory. Combined stocks in France, Greece, Mexico, Portugal, and Spain currently come close to equaling U.S. stocks. This compares with an average ratio of 1 to 3 for the previous 5 years.

If foreign production outside the Sino-Soviet bloc decreases substantially in 1962, as anticipated, part of the foreign rosin stocks are likely to be absorbed into consumption channels with a resulting lower carryover inventory next year. Many owners appear to be capable of carrying their enlarged inventories without resort to distress selling.

Second, in the United States, CCC is reverting to its traditional role—briefly interrupted in 1960 and 1961—of assuming a substantial part of the rosin inventory-carrying responsibility. Thus, on March 31, 1962, CCC loan rosin stocks constituted about 63 percent of the overall gum rosin inventory and 24 percent of the inventory of all types of rosin. However, as recently as 1959, CCC rosin represented 92 percent of all gum rosin stocks and 78 percent of the inventory of all types of rosin. While CCC stocks are expected to expand during 1962, the volume at the end of the year will be substantially lower than CCC inventory levels during the period 1952–59.

A third important development is the increased inventory-carrying load shouldered by the steam-distilled and tall oil rosin trade in the United States. As of June 30, 1962, these two types of rosin combined accounted for 58 percent of U.S. rosin stocks, compared with an average of 17 percent for the 10 years ending March 31, 1959. Steam-distilled wood rosin stocks (a large part of them FF grade), at their highest level since 1953, probably will be lower by April 1, 1963, if, as anticipated, steam-distilled production is curtailed further[9] and export prices are adjusted to market conditions. Stocks on March 31, 1962, represented about 14 percent of the previous year's steam-distilled output.

Tall oil rosin stocks on April 1, 1962, approximated 26 percent of the previous year's production, compared with 10 percent for 1961 and 6 percent for 1960. Because of continued increase in production and strong competition for the smaller 1962 export market, tall oil rosin stocks on April 1, 1963, are expected to be at or above the 1962 level.

These trends are shown in figure 42 and table 22.

Turpentine Stocks May Reverse Recent Upward Trend

World turpentine stocks have been rising since 1959, and in 1962 reached their highest point since 1953 (fig. 43). This trend through 1961 reflects increased world output coincident with relatively static consumption.

U.S. turpentine inventories have been increasing since 1959 and are at their highest level since 1944. CCC stocks comprised 15 percent of U.S. turpentine inventory on April 1, 1962. With a continuing CCC policy (as in 1961 and 1962) of not providing specific price support for gum turpentine, these stocks probably will be sold within the next 2 years. The upward trend in foreign stocks began 2 years earlier, and these stocks have reached their highest point since 1954. It is anticipated that reduced foreign output combined in 1962 with low current prices will further increase consumption in 1962 with a resulting lower worldwide carry-in next year.

[8] In 1951 and 1952, inventories in importing countries were extremely heavy and, combined with stocks in foreign producing countries, probably exceeded current foreign inventories.

[9] This production curtailment will be reflected in lower FF rosin output, with production of pale grades relatively unchanged.

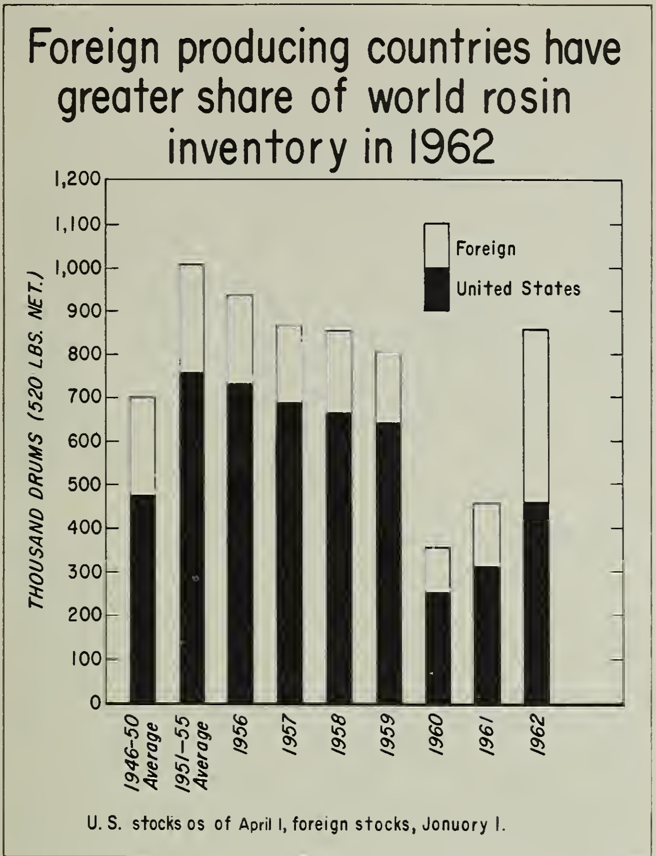


Figure 42

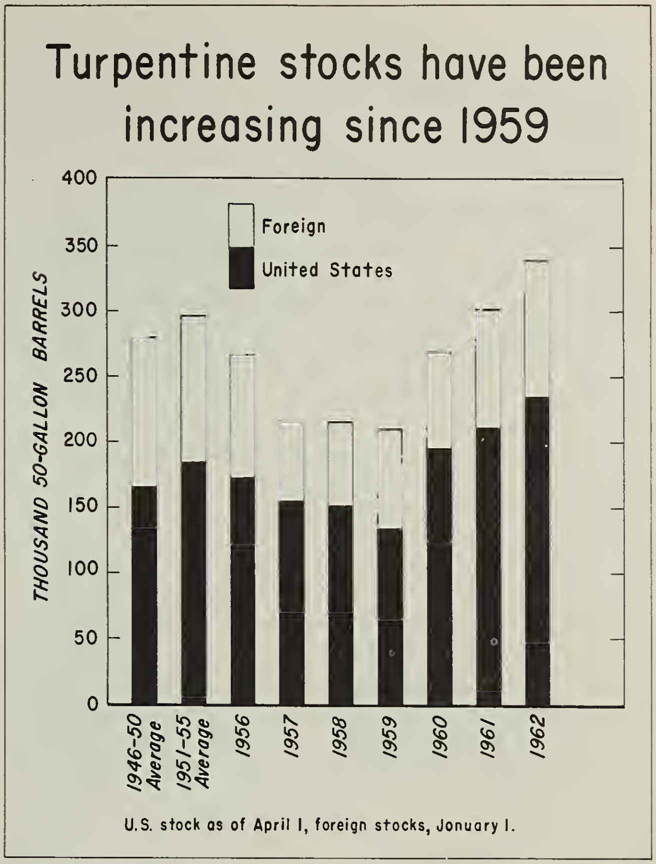


Figure 43

Tall Oil Stocks in 1962 Higher Than Previous Year but Lower Than 1960

U.S. tall oil inventories carried into 1962 were, in the aggregate, 22 percent higher than in 1961, but 16 percent below the 1960 carry-in level. The 1962 inventory increase is not significant because tall oil stocks in 1961 were at their lowest level since 1956, reflecting reduced 1960 output of tall oil coincident with increased tall oil rosin and fatty acid production. U.S. stocks of tall oil probably will mount next year, reflecting increased crude tall oil output and a less favorable demand situation, particularly for tall oil rosin. Information on foreign tall oil stocks is incomplete. However, since the United States accounts for about 80 percent of world production, trends in U.S. stocks indicate the world situation.

World Supplies of Rosin and Tall Oil Expected To Increase

Despite significantly reduced foreign production anticipated for 1962, supplies of rosin in the United States and abroad are expected to increase about 5 percent. In the United States, increases in gum and tall oil rosin supplies should more than offset a reduced supply of steam-distilled wood rosin. The increase in foreign supplies reflects expanded inventories anticipated in Western Europe. Increased tall oil supplies are expected as a combined result of greater U.S. output and inventories (fig. 44 and table 23).

World Supplies of Turpentine May Dip in 1962

World turpentine supplies reached their highest level on record in 1961. If foreign production declines, as anticipated, supplies may be slightly lower in 1962 (fig. 44). The reduction in foreign supplies is expected to more than offset an increase in supply of U.S. turpentine. At current price levels, a further reduction in world supplies is likely in 1963.

Many Factors Appraised in World Trade Analysis

World trade approximates the sum of requirements of individual countries in excess of their individual supplies. Production and stocks have previously been discussed, and foreign consumption and prospective requirements will be analyzed in a later section. Over and above basic relationships between supply and requirements, however, naval stores trade patterns are influenced by many factors such as relative prices, product character-

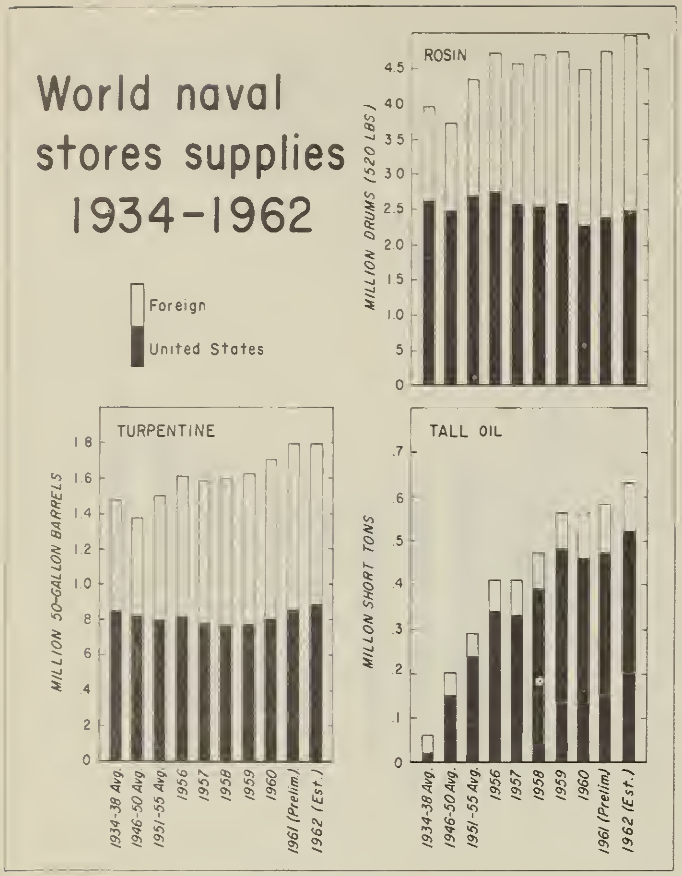


Figure 44

istics, and various trade arrangements and restrictions.

The United States dominates world naval stores markets because of its position as the leading naval stores producer. Actually, since the end of World War II, dollar deficits and, more recently, price competition and the trend to economic integration have relegated the United States to the role of residual supplier of naval stores to the world. Dollar deficits no longer are the problem they were in the principal naval stores markets in the years immediately following World War II. However, price competition has been intense notwithstanding that, in the long run, there has been no overproduction of naval stores. Although U.S. naval stores are highly esteemed for quality in foreign markets, price differentials between U.S. and foreign rosins often exceed any preference for the U.S. product. Future trade problems for U.S. naval stores are foreshadowed by the several western trade blocs established during the past 5 years.

The following analysis of world trade was based principally on export data. In certain cases, however, import data were used. For example, data on exports from Sino-Soviet-bloc countries generally were obtainable principally through import statistics of consuming countries.

Export Outlet Continues Important to United States

U.S. rosin, turpentine, and tall oil exports were valued at about $40 million in 1961. Before World War II (1934–38), exports provided nearly half of the overall market for U.S. rosin. In contrast, during the past 5 years exports comprised 30 percent of the market for U.S. rosin (fig. 45). Although, overall, United States disappearance was 10 percent higher in 1957–61 as compared with 1934–38, U.S. rosin exports were 28 percent lower.

Similarly, turpentine exports remain significant, although considerably below the pre-World War II level. Whereas during 1934–38 exports accounted for about 38 percent of overall U.S. disappearance, during the past 5 years this proportion was reduced to 12 percent.

Reduced rosin and turpentine exports reflect the diminishing share of the United States in an expanded world output. Moreover, notwithstanding increased foreign consumption, the volume of world naval stores trade has not recovered to prewar levels. U.S. exports have borne the brunt of the decline. The world outside the United States thus is moving closer to self-sufficiency as compared with the prewar situation.

Exports of crude and refined tall oil were relatively insignificant before World War II, when

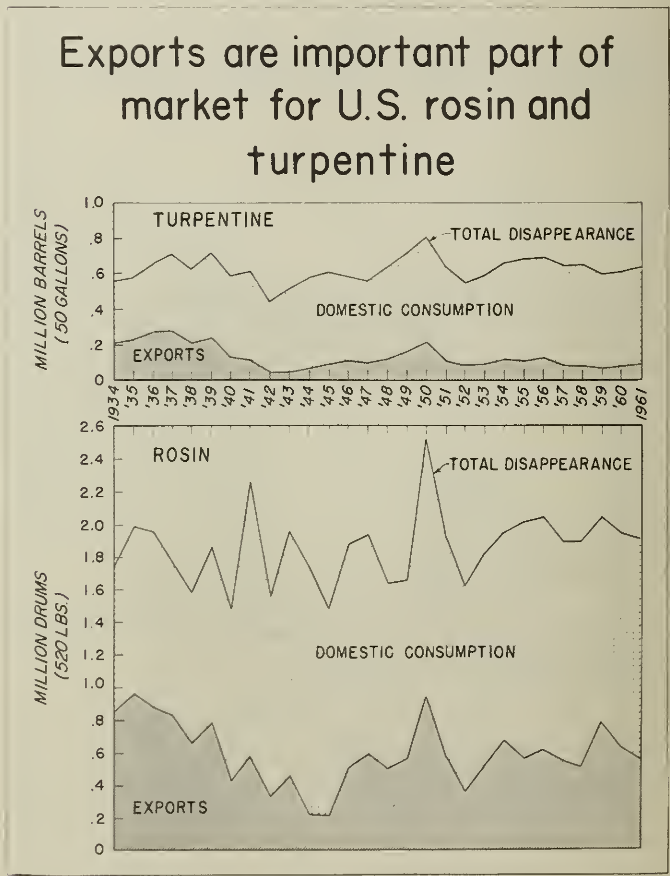


Figure 45

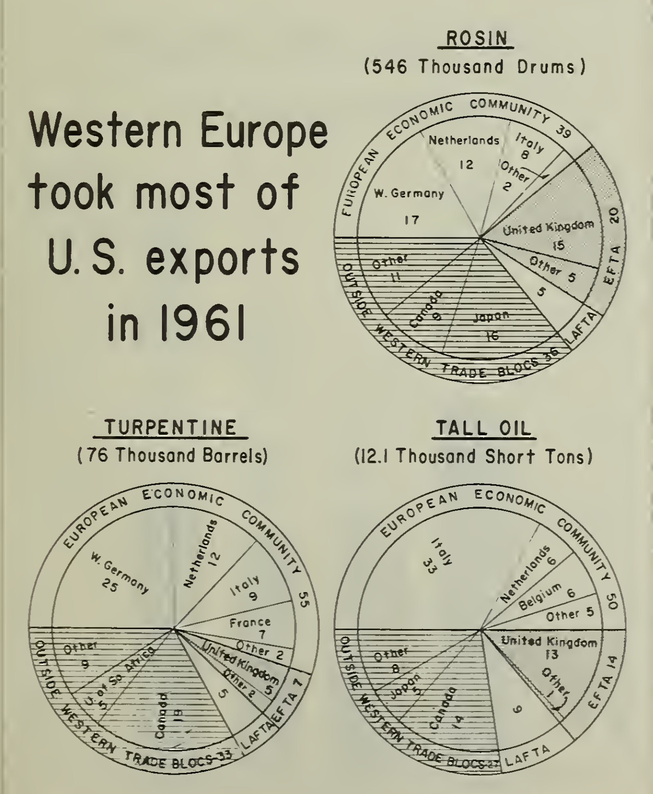
tall oil production was beginning in the United States. Following the war, output expansion exceeded development of domestic outlets, with the result that exports were relied on to absorb 10 percent of production. However, as fractionating capacity developed and expanded during the past 8 years, a smaller proportion of crude and refined tall oil was available for export. In 1961, less than 1 percent of crude tall oil output was exported, and combined exports of crude and refined tall oil aggregated less than 5 percent of output. However, appreciable quantities of the coproducts of fractionation, tall oil rosin and fatty acid tall oil, are available for export. During 1961, for example, about 16 percent of the tall oil rosin output and 15 percent of the production of tall oil fatty acids were exported.

Most U.S. Exports Directed to Western Europe

Western Europe takes well over half of U.S. exports. In 1961 about 60 percent of U.S. rosin exports were directed to this area (fig. 46 and table 24). Over the years, the United Kingdom, West Germany, Netherlands, Japan, Italy, Canada, Australia, and the Scandinavian area have been our leading customers. In 1961 about 17 percent of U.S. rosin exports went to West Germany, followed by Japan (16 percent), United Kingdom (15 percent), Netherlands (12 percent), Canada (9 percent), Italy (8 percent), Australia and the Scandinavian countries (4 percent each). In 1962, owing to increased European supplies and the differential between U.S. and foreign prices, it may be that a smaller proportion of U.S. rosin exports will be directed to Western Europe.

Before World War II, about three-fourths of U.S. turpentine exports were directed to Europe. Since then, the proportion has been lower averaging slightly over three-fifths (fig. 46 and table 25). Of the 76,000 barrels exported in 1961, about 65 percent went to Europe (to West Germany, Netherlands, Italy, and France in descending order of volume) and 18 percent to Canada. Unless Communist-bloc exports unexpectedly rise or turpentine prices advance substantially, a higher proportion of U.S. turpentine exports may go to Europe in 1962 because of reduced turpentine availabilities from Western European producers.

In 1961, Europe received about 64 percent of U.S. crude and refined tall oil exports. This proportion has been declining throughout the post-World War II years, reflecting trade shifts to Canada, Latin America, Japan, and Australia (fig. 46 and table 26). Italy, Canada, and the United Kingdom were the leading recipients of U.S. tall oil in 1961.



Note: Figures in diagrams are percentage of total U.S. exports, 1961.

FIGURE 46

Western Europe Principal Recipient of All World Trade

Not only is Western Europe the destination of most U.S. naval stores exports, but it imports considerably more naval stores of all origins than the rest of the world together (fig. 47 and tables 27 and 28). During the 5 years 1956–60, Western Europe was the target of 64 and 81 percent of the world's rosin and turpentine trade, respectively. The proportion of rosin world trade directed to Western Europe has not changed much over the past 30 years. However, Western European turpentine imports in relation to the world total, while still below the pre-World War II level, have been trending upward since the end of the war.

During 1956–60, the United Kingdom was the world's leading importer of rosin (23 percent of the world total), followed by West Germany (15 percent), Netherlands and Japan (8 percent each), Italy (6 percent), the U.S.S.R.[10] and Brazil (5 percent each), and Canada (4 percent). The Latin American area currently receives about 10 percent of world rosin exports; the Sino-Soviet bloc, 8 percent; and the Scandinavian countries, 6 percent. Until world trade declined sharply in 1961, the trend since the end of World War II had been upward. With consumer stocks abroad now down to normal, world rosin imports probably will increase in 1962.

[10] Mainly from Communist China.

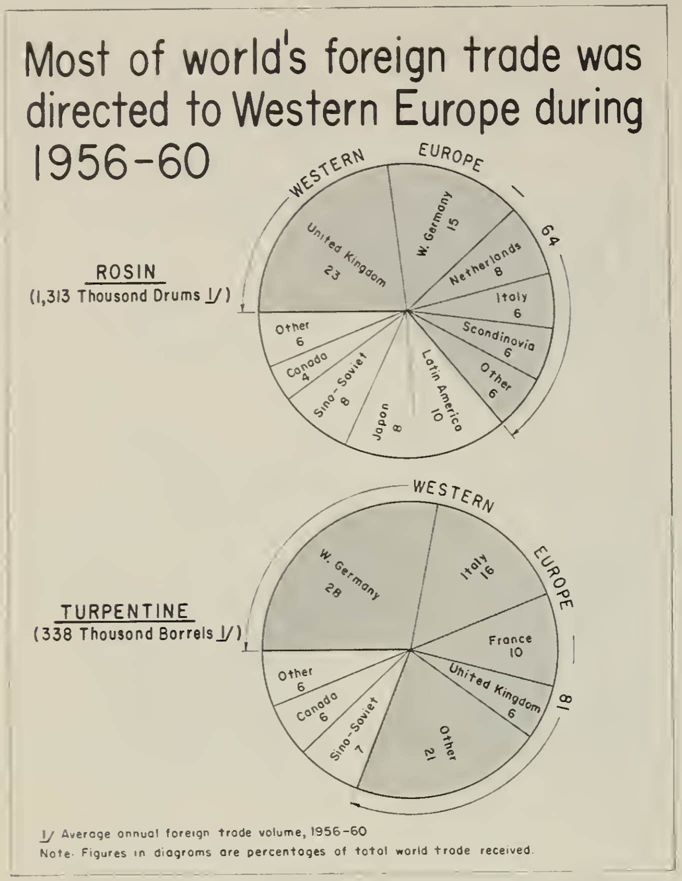


FIGURE 47

United States Remains Most Prominent Exporter but Role in Foreign Trade Is Diminishing

The United States exported 546,000 drums of rosin and 76,000 barrels of turpentine in 1961. Although this exceeded the exports of any other country, U.S. exports have been declining in relation to the world total. In the 5 years before World War II, the U.S. share in world rosin trade was 61 percent, compared with 46 percent during the period 1956–60 and 48 percent in 1961 (fig. 48 and table 29).

Portugal ranks next to the United States in rosin trade, accounting for about 16 percent of world trade during the period 1956–60. Of the remaining major exporting countries, China ranked third with 11 percent of world trade, followed by Greece, 7 percent; Mexico, 6 percent; Spain, 4 percent; and France and the U.S.S.R. with about 3 percent each.

The declining U.S. position in world trade is far more apparent in turpentine. During 1934–38, about half of world turpentine trade originated in the United States. This compared with about one-fourth during 1956–60 and one-fifth in 1961 (fig. 49 and table 30). U.S.S.R. exports surpassed those of the United States in 1959, the first time in this century that the United States failed to lead

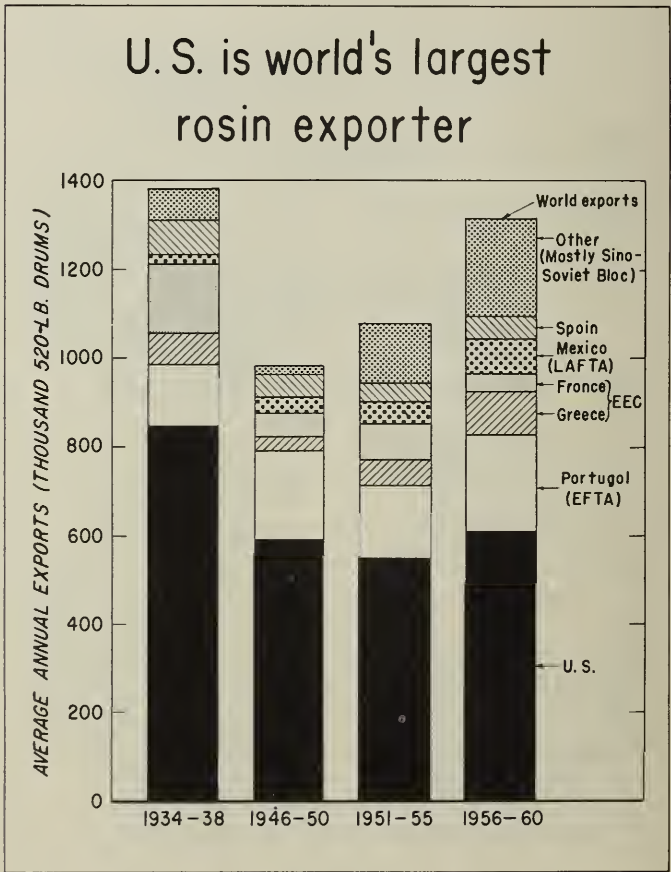


FIGURE 48

Turpentine imports are somewhat more concentrated. About 28 percent of world trade in turpentine goes to West Germany. Italy receives 16 percent of the world trade; France (on a net import basis since World War II), 10 percent; the United Kingdom and Switzerland and Canada, about 6 percent each. Imports of turpentine have been trending upward since the end of the war, with increased shipments to West Germany, Italy, and France more than offsetting generally declining trade elsewhere in the world.

Foreign dependence on naval stores imports has been declining over the past 30 years. Thus, during the 5 years 1956–60, about 52 percent of foreign rosin requirements were met through imports, as compared with 70 percent in the 5 years before World War II. Similarly, turpentine imports represented 39 percent of foreign requirements during 1956–60, as compared with 66 percent during 1934–38. Southern Hemisphere countries and Western Europe are most dependent on imports. Virtually no naval stores are produced south of the Equator. Currently, Western Europe imports about half of its rosin requirements and three-fourths of its turpentine needs.

in turpentine exports. Last year, Portuguese exports were only 3 percent less than those of the United States. During the period 1956–60, the leading foreign exporters and their shares of total foreign trade were: U.S.S.R., 18 percent; Portugal, 15; Sweden, 13; Mexico and China, 8 percent each; Greece, 5; and Finland, 4. It will be noted that exports from Western Europe were about double those of the United States.

Except during extreme years (1950, 1952, and 1960), U.S. rosin exports have shown no marked trend since the end of World War II, and have averaged about 550,000 drums. U.S. turpentine exports, however, have trended downward, reflecting in part the marked consumption decline in such import markets as the United Kingdom and Latin America despite increasing world consumption.

The U.S. share in world rosin trade probably will be significantly lower in 1962. Increased foreign export availabilities and lower foreign prices are expected again to relegate the United States to its long-term role as a residual supplier of rosin. On the other hand, as long as prices remain near current levels the U.S. share of world turpentine trade is likely to be maintained, if not increased.

About 37 percent of the foreign trade in crude and refined tall oil originated in the United States during recent years as compared to 40 percent in Sweden and 16 percent in Finland. The U.S. share in world crude and refined tall oil trade is expected to decline in the next decade, coincident with increased domestic demand for crude tall oil for fractionation and increasing and more dispersed foreign output. On the other hand, increased trade is likely in tall oil rosin and fatty acid tall oil, the coproducts of crude tall oil fractionation.

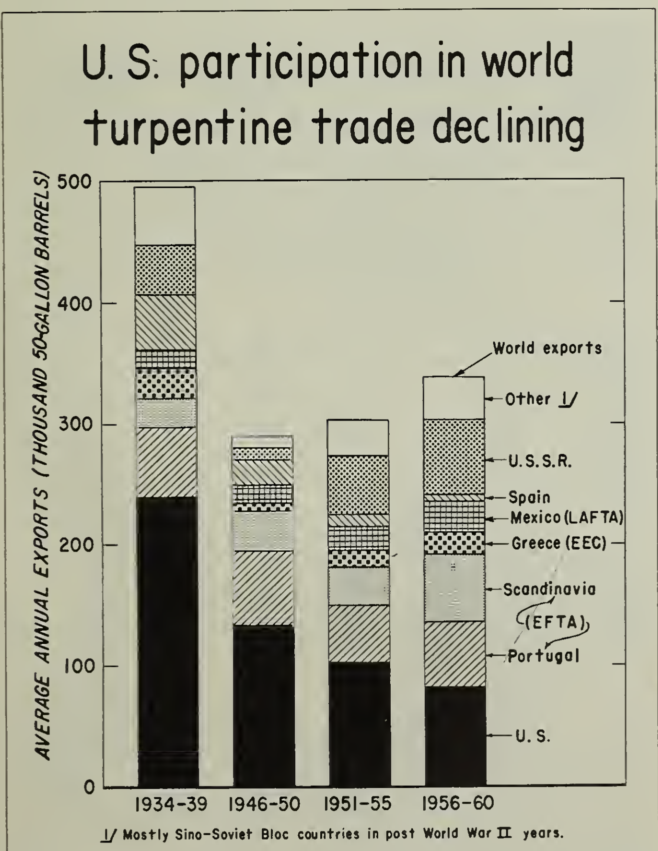


FIGURE 49

Economic Integration May Affect U.S. Naval Stores Trade

Naval stores trade will likely be affected by the worldwide trend toward economic integration, as will trade in other commodities which are heavily dependent on exports to move a significant part of their production. Currently, the economic trade blocs of greatest significance to naval stores are the European Economic Community (EEC, popularly referred to as the European Common Market), the European Free Trade Association (EFTA), the Latin American Free Trade Area (LAFTA), and the Central American Common Market.[11]

The EEC currently is comprised of West Germany, France, Italy, Netherlands, Belgium, and Luxembourg. Greece is an associate member. EFTA membership consists of Austria, Denmark, Norway, Portugal, Sweden, Switzerland, and the United Kingdom. Finland is an associate member. The LAFTA bloc encompasses most of Latin America including Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, and Uruguay. Guatemala, El Salvador, Nicaragua, and Honduras comprise the Central American Common Market.

All trade blocs are eliminating internal tariffs and quotas. However, whereas the EEC is erecting a common tariff wall against outsiders, the other blocs permit their members to retain individual external tariffs on imports originating outside the bloc.

Each of these trading groups by its very nature ultimately will tend to operate against the other, and against the United States and other outsiders. Mergers between certain of the blocs appear likely. All of the EFTA members (except associate member Finland[12]) have applied for membership or affiliation with the bigger and faster growing EEC. Also, it may be that LAFTA eventually will expand to encompass virtually all of Latin America, except Cuba.

[11] For a more comprehensive analysis see "Economic Integration in the Western World and Its Effect on U.S. Naval Stores Exports," U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, March 1962.

[12] Because of Finland's situation vis-a-vis the U.S.S.R., the chances of EEC membership or association are remote, barring an end to the "cold war."

If current plans of the trade blocs to eliminate internal trade obstacles and erect barriers to outside trade are carried out, shifts in rosin and turpentine trade will occur which may affect the United States. This merits close study since in 1961, for example, about two-thirds of U.S. rosin and turpentine exports and nearly three-fourths of our tall oil exports were directed to these trade blocs (fig. 46).

Trade Blocs Need Rosin From Outside Sources but Are More Self-Sufficient in Turpentine

The trade blocs generally are heavily dependent on rosin from outside sources to meet their requirements (fig. 50). Even if all of rosin produced in the EEC during the period 1956–60 had been retained within the bloc, less than half of EEC requirements would have been met. Similarly, production within the EFTA was sufficient to cover only about three-fifths of consumption. The Latin American blocs produced 84 percent of their rosin requirements during 1956–60, while in 1961 their output exceeded their requirements.

Overall, the trade blocs were more self-sufficient with respect to turpentine and tall oil. While the EEC produced only 37 percent of its turpentine requirements during 1956–60, the other blocs had a substantial export surplus (fig. 51). EEC tall oil production covered only 5 percent of its requirements, and the small requirements of the Latin American blocs were met almost entirely through imports. The EFTA, however, with Sweden and Finland major producers of tall oil, was on an export basis.

During the past several years naval stores trade has flowed freely across bloc boundaries, apparently indifferent to considerations of self-sufficiency. In 1961, for example, only 26 percent of the rosin exports of EEC producing countries were directed to EEC consumers. The corresponding percentages for EFTA and LAFTA were 52 and 23 percent, respectively. The situation was similar for turpentine in 1961, with only 31 percent of EEC exports, 11 percent of EFTA trade, and 2 percent of LAFTA shipments intrabloc.

Bloc Policies May Cause Shift in Trade Patterns

Based on announced policies of the several trade blocs, future shifts in rosin trade patterns are likely both between trade areas and between each bloc and the outside world. Other factors being equal, removal of internal trade restrictions and ultimate imposition of uniform external tariffs should tend to keep a greater proportion of French and Greek exports within EEC boundaries. If

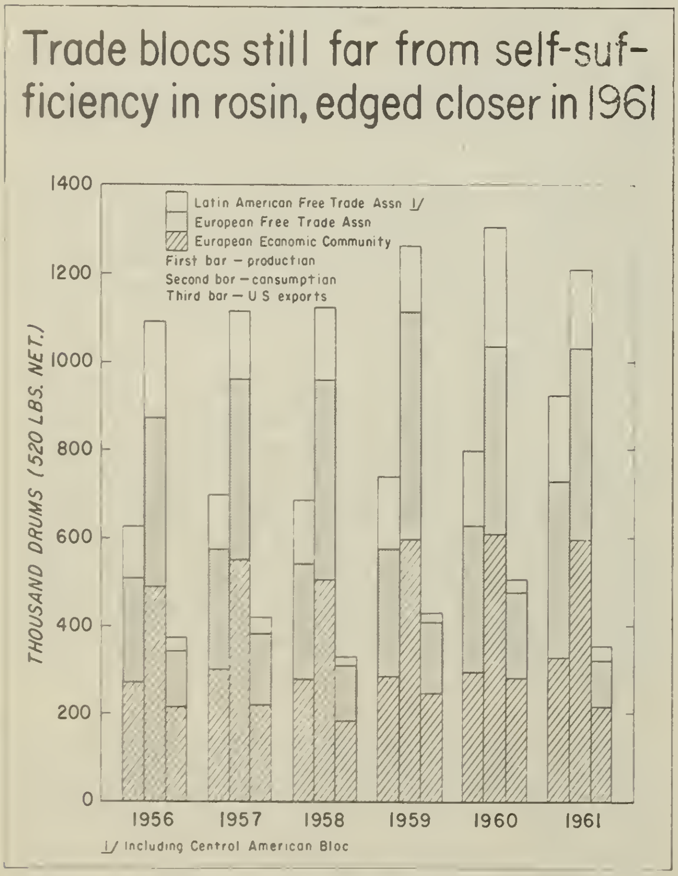


FIGURE 50

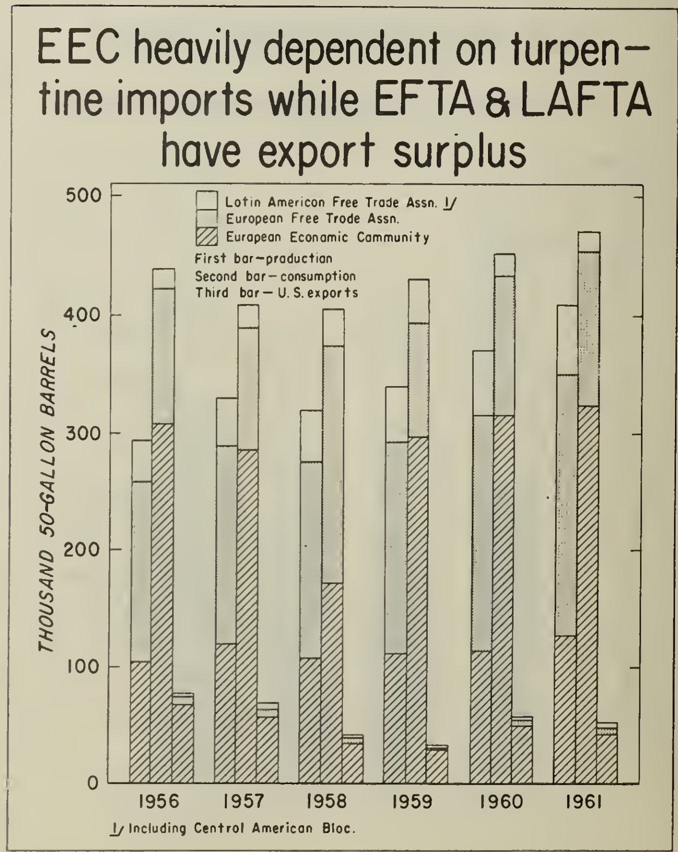


FIGURE 51

and when Portugal or Spain joins or affiliates with EEC, little change is likely to occur in their trade patterns because the great bulk of their exports is directed either to present or prospective EEC members. Mexican rosin exports, reflecting that country's favored position as a member of the highly protective LAFTA, are expected to shift to Latin America. This would create a supply vacuum in Western Europe into which may flow rosin from the United States, West Europe, and the Sino-Soviet bloc. Since Western Europe as a whole is on an import basis for rosin, the United States will continue as a primary residual source of supply.

Turpentine trade patterns are not likely to change much. France is not on an export basis and Greek turpentine already is largely directed to EEC countries. Similarly, nearly all other turpentine export availabilities from Western Europe now are directed either to the EEC or to countries planning to join or affiliate with that bloc. More Mexican turpentine may in the future be directed to LAFTA countries. However, the turpentine import requirements of the Latin American bloc are expected to continue limited until these countries are more fully industrialized. The outlook for U.S. turpentine in trade-bloc markets is favorable at or near present price levels.

United States Acts To Adjust to Trade Block Challenge

The EEC necessarily must obtain most of its naval stores requirements from outside sources and has no prospects of becoming self-sufficient during the 1960's. Under these circumstances its external tariff on these products is primarily revenue producing rather than protective in nature. The United States has acted to adjust to the new trading arrangements through GATT [13] negotiations and by means of the Trade Expansion Act of 1962.

At the recently concluded GATT negotiations, ultimate EEC external tariff rates were reduced by one-sixth on rosin from 6 to 5 percent ad valorem, one-fifth on turpentine from 5 to 4 percent, and were eliminated entirely on crude tall oil. While these reductions had no effect on current naval stores trade, they ameliorated the eventual effect of the EEC external tariff.

In order to cope with any trade impact resulting from differential tariff situations and to strengthen economic and political relations with the EEC and with other foreign countries, the United States had two alternatives: (1) Attempt to join an enlarged EEC to form an Atlantic Common Market or (2) replace the Reciprocal Trade Agreements Act with more liberal and flexible trade legislation that would give the President authority to bargain down EEC's external tariff and extend the resulting mutual concessions to other free world nations. The United States chose the second alternative in legislation termed Trade Expansion Act of 1962.

The Trade Expansion Act of 1962 should afford opportunity for a further reduction in the EEC external naval stores tariff as well as for reducing or eliminating naval stores tariffs of countries outside the EEC.

Foreign Consumption Increasing—U.S. Consumption Relatively Static

In contrast to the relatively static consumption of rosin and turpentine in the United States, overall foreign consumption of these commodities has been increasing during the post-World War II era. This is to be expected because the vast industrial plant of the United States emerged relatively unscathed from the war and rapidly converted to peacetime requirements. On the other hand, most of the Eastern Hemisphere, with its industry in ruin, began the long, hard climb back to industrialization.

U.S. rosin consumption during the 15-year postwar period 1946–60 averaged 1.36 million drums, about the same as in 1961. However, foreign rosin consumption has trended upward (fig. 52), reaching a peak of 2.75 million drums in 1960, about 131 percent above the 1946 level. Following record high prices during the summer and fall of 1960, foreign consumption in 1961 declined about 5 percent to 2.61 million drums. The increase in foreign rosin consumption since the end of World War II has been especially marked in the Sino-Soviet bloc, Japan, and West Germany, and somewhat more moderate in Western Europe as a whole (table 31). On the other hand, consumption has trended slightly downward in Latin America where the principal use for rosin has been in soap, an outlet now nonexistent in the United States and long on the decline elsewhere in the world. Despite some trade impression to the contrary, both foreign and worldwide consumption in 1961 exceeded any other post-World War II year except 1959 and 1960.

World turpentine consumption reached alltime record heights in 1961 under the stimulus of unprecendentedly low prices. Postwar trends in U.S. turpentine consumption are inconclusive, with rising industrial utilization of turpentine offsetting declining retail sales. (This trend apparently has been reversed in the past 2 years owing to intensive retail merchandising efforts at reduced prices to offset losses in the synthetic pine oil market.) Elsewhere, turpentine consumption generally has been increasing with Latin America, the

[13] The General Agreement on Tariffs and Trade is an international trade agreement entered into by the U.S. (under the Trade Agreements Act) covering virtually all of the important trading nations of the free world. It is the most comprehensive agreement ever concluded for the reduction of barriers to, and hence for the expansion of, international trade, considering the number of participating countries, the scope of its provisions, and the volume of trade affected.

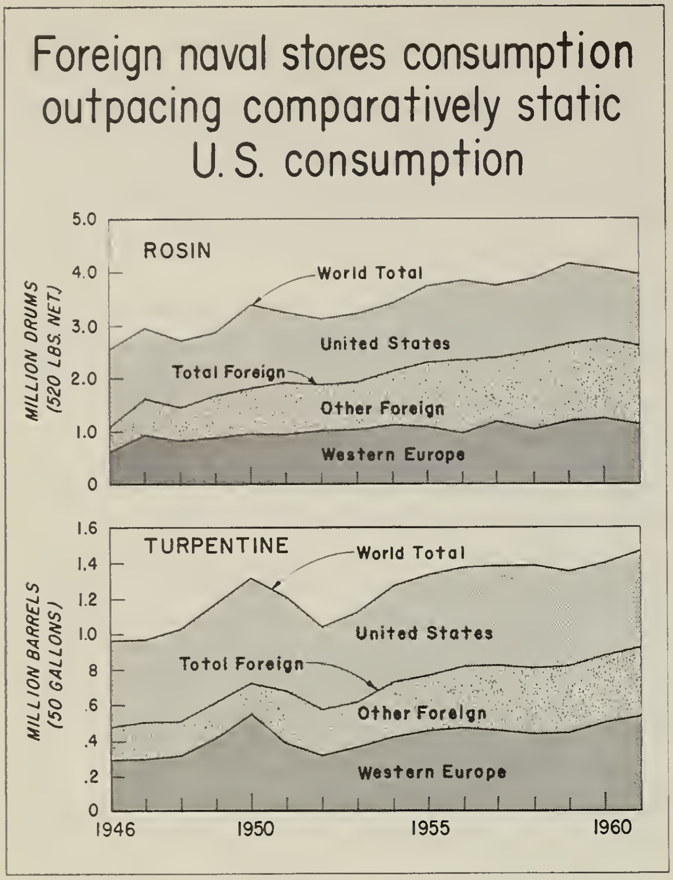


FIGURE 52

United Kingdom and Canada being significant exceptions. In some countries (the United Kingdom, for example) curtailment reflects in part past import restrictions and the alternative importation and consumption of turpentine fractions rather than whole turpentine. Between 1956 and 1961 Western European turpentine consumption increased by 80 percent. The corresponding increase is estimated at more than fourfold in the Sino-Soviet bloc. Overall, foreign turpentine consumption rose about 94 percent from 477,000 barrels in 1946 to an estimated 923,000 barrels in 1961.

U.S. consumption in 1961 approximated 34 and 37 percent of the world total for rosin and turpentine, respectively. Western Europe accounted for about 28 percent of world rosin consumption; the Sino-Soviet bloc, 23 percent; Latin America, 5 percent; and Japan, 3 percent. About seven-eighths of foreign turpentine consumption in 1961 occurred in Western Europe and the Sino-Soviet bloc. Western Europe's turpentine consumption was 36 percent of the world total, while the Sino-Soviet bloc absorbed nearly one fifth of world consumption.

U.S. Per Capita Consumption Is World's Highest

Per capita consumption of rosin and turpentine by countries and areas is included in table 31. These commodities are industrial in usage and therefore not directly dependent on population growth. The fact that world rosin and turpentine consumption correlates positively with the population trend is coincidental.

The data are of interest mainly as a measure of intensity of rosin utilization in various areas of the world and as a very rough indication of maximum consumption potentialities in an industrialized world. Per capita rosin and turpentine consumption has been declining in the United States and increasing abroad. U.S. per capita consumption in 1961 was slightly under 4 pounds of rosin and about 19 ounces of turpentine. Abroad, estimated per capita rosin consumption in 1961 ranged from about 1¾ pounds in Western Europe to less than one-tenth pound in Africa and Asia (excluding Japan and Communist China). The range in per capita turpentine consumption was even more extreme, varying from 10 ounces in Western Europe to less than two-thirds ounce in Latin America and about four-tenths ounce in Africa and Asia, exclusive of Communist China.

Foreign Rosin Consumption May Rise to 3.6 Million Drums by 1970

During the period 1946–60, foreign rosin consumption was closely related to foreign industrial productivity. However, whereas foreign industrial productivity [14] grew at an average rate of more than 10 percent annually between 1946 and 1960, the corresponding average annual increase in foreign rosin consumption was about 6 percent. The increase in both foreign industrial productivity and rosin consumption was steeper in the period immediately following World War II than in more recent years. Thus, during the first 5 postwar years, industrial productivity and rosin consumption increased 14 and 11 percent, respectively, as compared with about 9 and 4 percent during the 5-year period 1956–60. This reflects largely the low level of industry in the Eastern Hemisphere following the devastation of World War II.

Analysis of foreign consumption trends for the period 1946 through 1960 (with time and foreign industrial productivity as the independent variables and assuming an average growth in foreign industrial productivity of 6 percent anually) points to foreign consumption of about 3.85 million drums by 1970. This represents an increase of 47 percent, or nearly 1.25 million drums, over the estimated 1961 level of foreign consumption, or a growth rate of 4½ percent annually. Under alternate assumptions of annual growth in foreign industrial productivity of 7 and 5 percent, the change in projected consumption is about 60,000 drums, more and less, respectively.

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[14] Based on indexes published in U.N. Monthly Bulletin of Statistics recomputed to reflect industrial activity of Sino-Soviet bloc.

Projection of the above relationships beyond 1960, however, necessarily implies continuance of the basic conditions and price relationships prevailing during 1946–60. Thus, prices prevailing during this period averaged $9 per 100 pounds, net in drums, f.o.b. U.S. processing plants, based on 1961 dollars. It is clear from production and consumption trends since 1946 that at this price level foreign consumption requirements will far outpace foreign production. Moreover, unless costs of producing U.S. gum naval stores are curtailed significantly, output at a $9 rosin price (and with turpentine prices unprecedently low) would be likely to decline. In these circumstances, production of all types of rosin in the United States by 1970 is unlikely to exceed 1.8 million drums, nearly all of which would be required for domestic consumption. It is equally clear from events of the past 2 years that, at prices approximating $12 or more, the growth rate of foreign production is likely to surpass that of foreign consumption with the result that by 1970, the world outside the United States is likely to be self-sustaining in naval stores.

The long-term equilibrium price for rosin thus appears to be somewhere between $9 and $12, and for this analysis is assumed to be $11.50. Under this assumption, it is estimated that foreign consumption will approximate 3.6 million drums in 1970. This represents an increase of 38 percent, or nearly 1 million drums, over the 1961 level and a growth rate of about 3½ percent annually (fig. 53).

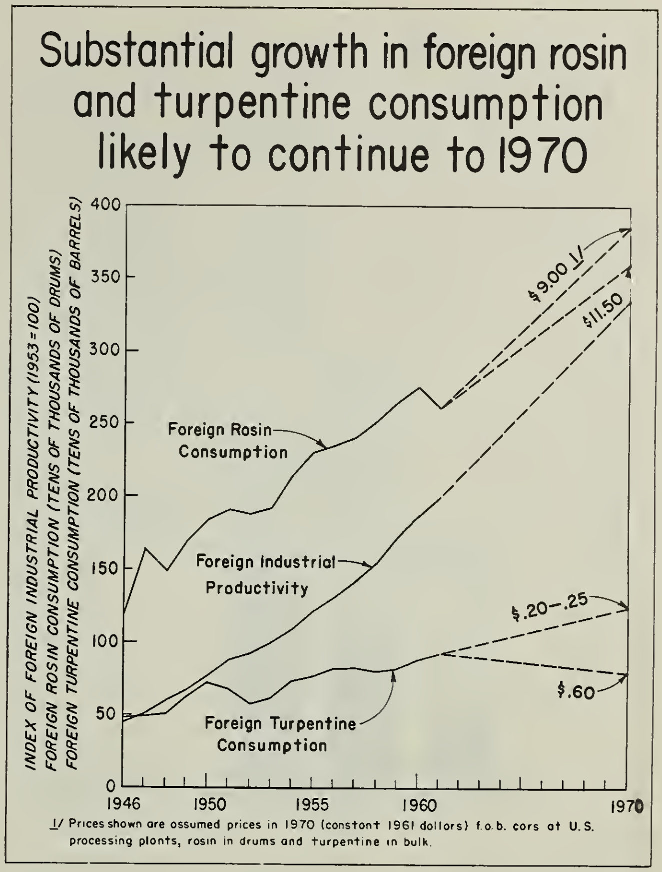

Figure 53

Growth in Future Rosin Requirements Abroad Related Mainly to Paper and Rubber Outlets

Between 1949 and 1959, rosin consumption abroad rose 57 percent from 1.7 to 2.7 million drums. About 60 percent of this 1 million drum expansion represented increased utilization in sizing paper (fig. 54 and table 32).

Information on consumption trends abroad by end use often is incomplete or too generalized. For many countries, breakdowns by end uses are not obtainable and estimates for such countries are based on reported consumption estimates of countries in the same general area and having similar industrial output characteristics. On the whole, the factors affecting the major uses of rosin in the United States also are operable abroad, and the explanation of trends in specific domestic markets is in some instances applicable to the foreign market as well. However, the overall foreign market is a summation of many individual and often highly contrasting markets (table 32). The following description dwells mainly on foreign utilization patterns as a whole, pointing out contrasts or similarities to the U.S. market as well as regional tendencies.

In general, a greater proportion of rosin consumed abroad goes into paint and varnish, soap, and linoleum than of that consumed in the United States. On the other hand, foreign countries tend to use less rosin proportionately in rubber, adhesives, and printing ink.

Paper.—Rosin is the principal constituent of a paper size widely used by the papermaking industry. Rosin size is added to the pulp in the cooking process in contrast to another type which is applied to the finished paper. Wrapping paper, paperboard, newsprint, and some book papers are rosin sized. Over the years, changes in consumption of rosin for size in individual foreign countries have followed very closely the output of paper and board in each country.

About 38 percent of the rosin consumed abroad in 1959 went into paper. This was about the same proportion as U.S. utilization that year and compares with 25 percent 10 years earlier. Based on projections of the Food and Agriculture Organization of the United Nations covering world demand for paper in 1965 and 1975 (*11*), it is esti-

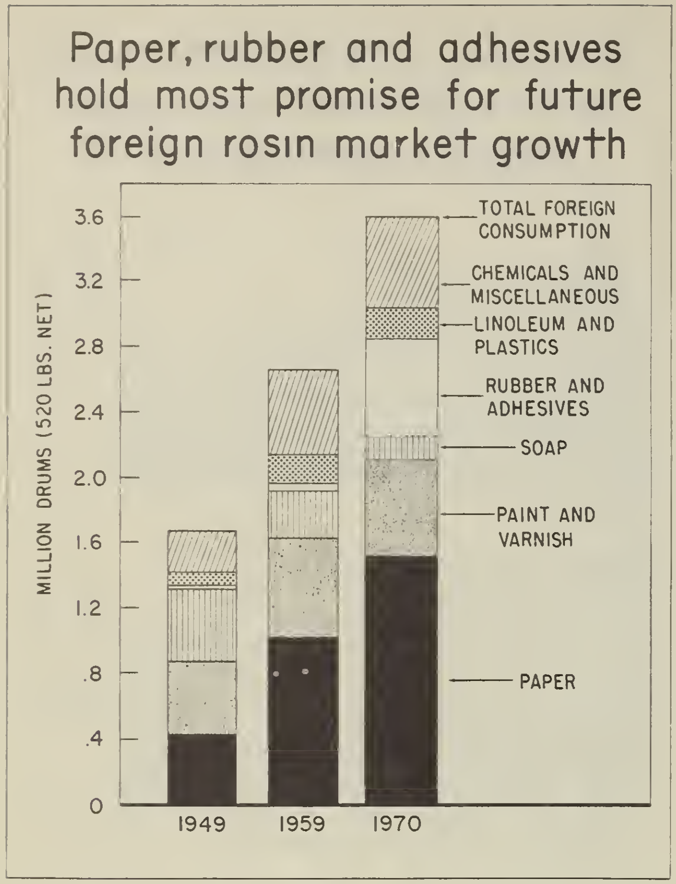

FIGURE 54

mated that foreign production of paper and board will increase by about 77 percent between 1959 and 1970. This constitutes a growth rate averaging about 6 percent annually. On this basis, and assuming continuance of the 1959 average rate of rosin utilization abroad for sizing a ton of paper and board (about 11.9 pounds per short ton), foreign requirements for this purpose would total nearly 1.8 million drums of rosin by 1970. Here again, the assumptions inherent in this projection include maintenance of 1959 market conditions, including price levels. Based on market performance during the past 3 years it is estimated that at U.S. rosin prices of about $11.50 per 100 pounds, rosin size utilization abroad would be reduced about 15 percent to about 10 pounds [15] per short ton of paper and board. This reduced factor would result in foreign consumption of about 1½ million drums of rosin for paper size in 1970, an increase of nearly 50 percent or one-half million drums as compared with 1959.

Rubber and adhesives.—Rosin has a number of distinct applications in rubber and adhesives. It is used as an extender and as a processing aid in the compounding of natural rubber. Also, it is used as a tackifier. However, its principal use is as an emulsifier in the production of synthetic rubber. A growing market for rosin is in adhesives, including pressure sensitive tapes as well as rubber, latex, and hot melt adhesives.

Rapid growth is expected during this decade in foreign utilization of rosin in rubber and adhesives. This market accounted for less than 2 percent of foreign rosin consumption in 1959 because foreign production of synthetic rubber was comparatively small, about 270,000 short tons, exclusive of the Sino-Soviet bloc. Foreign output, however, expanded rapidly and reached 616,000 short tons in 1961. With continued expansion expected, production might reach 4½ million tons by 1970.[16] Current plans for capacity expansion include (in contrast with the situation in the United States) a proportionate share of S-type rubber. Assuming that this proportion of S-type to other synthetic rubbers continues to be maintained, this market (including adhesives) for rosin may expand from 40,000 drums in 1959 to 600,000 drums by 1970. This would place the rubber and adhesive outlet for rosin in competition with paint and varnish as the most important foreign market, next to paper size. The extent to which stereo rubber [17] production eventually will become established abroad is uncertain. However, it is assumed that any accompanying slowdown in growth of S-type rubber production in non-Communist areas will be more than offset by increasing S-type output throughout the Sino-Soviet bloc.

Soap.—Rosin is a saponifiable material; that is, it will combine with alkalis to form soaps. It serves the same function in soapmaking as the fatty acids obtained from fats and oils, but is not suitable for use in soap alone. Rosin ordinarily is limited to about 15 percent of the total saponifiable material used in soap.

Whether or not rosin is to be used in soap depends on price and various technical factors. Most important is the relative price of fats and oils substitutes. For the most part, these substances are available abroad at lower prices than rosin. The character of the fats and oils available for soapmaking also is a principal determinant. Rosin produces a soft soap and, if animal tallows are used preponderantly for soapmaking, the addition of rosin is desirable.[18]

Various technical problems also influence the

[15] This compares with current U.S. rosin size utilization of about 8 pounds per ton of paper and board.

[16] Estimate based on projections to 1967 by the International Rubber Study Group, London, United Kingdom, 1962.

[17] A new type of synthetic rubber which presently includes no rosin in its formulations.

[18] Timber Requirements for Naval Stores, USDA, Forest Service, June 1941.

demand for rosin in soap. Rosin soaps are yellow colored and encounter consumer prejudice in competition with white soaps. Rosin also is used abroad in controlled suds detergents.

Rosin utilization in soap, only a memory in the United States, accounted for an estimated 11 percent of foreign rosin consumption in 1959. It continued as the most important outlet for rosin in Latin America in 1959 and accounted for nearly one-fourth of the rosin consumed throughout Asia and Africa. The abundance of cheap tallow has been a major factor in holding the Latin American market. Overall, this end use is declining, since 10 years earlier it accounted for about one-fourth of foreign rosin consumption. By 1970, consumption may equal barely half the estimated 0.3 million drums consumed in 1959.

Paint and varnish.—Rosin is an element of the protective coating in varnish and enamel products. The history of the use of rosin in varnish is one of constant adaptation, which has made possible the displacement of the high-priced fossil gums originally used almost exclusively in varnish-making. However, over the past 30 years, synthetic resins have become increasingly competitive.

Notwithstanding this increased competition and contrary to the U.S. trend, foreign consumption of rosin in paint and varnish increased during the 1950's. In 1959, consumption totaled more than 0.6 million drums, about 23 percent of overall foreign rosin consumption, and was 38 percent higher than estimated consumption for this purpose in 1949. The 3.5-percent annual growth rate in the market from 1949 to 1959 was halted by high prices in 1960. Because of the consequent accelerated invasion of this market by substitutes, not much change is expected by 1970 in volume utilized at the assumed price level.

Other uses.—Little information is available as to probable trends in utilization of rosin abroad for purposes other than those discussed above. It is assumed for the purposes of this analysis that there will be relatively little change in volume consumed.

Foreign Turpentine Consumption May Rise to 1.25 Million Barrels by 1970

Foreign consumption of turpentine has increased at an annual rate of about 4½ percent since the end of World War II, compared with 6 percent for rosin and 10 percent for foreign industrial productivity. During this period, turpentine prices averaged about $0.60 per gallon (in 1961 dollars) bulk, f.o.b. U.S. processing plants. Although new industrial markets were developed and expanded, turpentine continued to be utilized significantly in traditional applications such as paint, varnish, and polish. The turpentine market weakened in 1960 and a substantial price decline was averted only by acquisition by CCC of about 6 percent of total U.S. output. The following year, with no sustaining CCC price-support loan, prices declined precipitously to about one-third of their average 1946–60 level.

Among the factors at the root of this price decline are (1) the continuing growth in markets for water-based paints at the expense of oil-based paints; (2) invasion of the synthetic pine oil market by petroleum derivatives; (3) increased production, particularly abroad, stimulated by soaring rosin prices in 1960; (4) poison labeling regulations proposed and published by the Food and Drug Administration in the Federal Register in April 1961 and later substantially revised and ameliorated, after a sharp drop in turpentine prices and industrywide protest; and, perhaps most significant, (5) the relatively inelastic demand for turpentine.[19]

However, at current low prices foreign consumption is expected to increase.

Assuming that turpentine prices will average about $0.20–$0.25 per gallon, foreign turpentine consumption is expected to reach 1.25 million barrels by 1970 (fig. 53). This would be an increase of 35 percent, or nearly one-third million barrels, as compared with 1961 consumption. Under present market conditions, turpentine consumption probably would decline if an attempt were made to return to price levels prevailing during 1946–60.

Paint, Varnish, Cleaners, and Polishes Account for Most Foreign Turpentine Consumption

About 60 percent of foreign turpentine consumption in 1959 was used in paint and varnish (including retail use) and 20 percent in the cleaning and polishing industry. This does not differ significantly from the consumption pattern 10 years earlier. "Chemicals and pharmaceuticals," a catchall industrial category, accounted for about 20 percent of foreign consumption in 1959 as compared with 18 percent 10 years earlier (fig. 55 and table 33).

For decades, the principal turpentine marketing problem had been too much reliance on one outlet,

[19] Under inelastic market conditions, a given percentage reduction in requirements (or increase in supply) is apt to generate a proportionately greater decline in price.

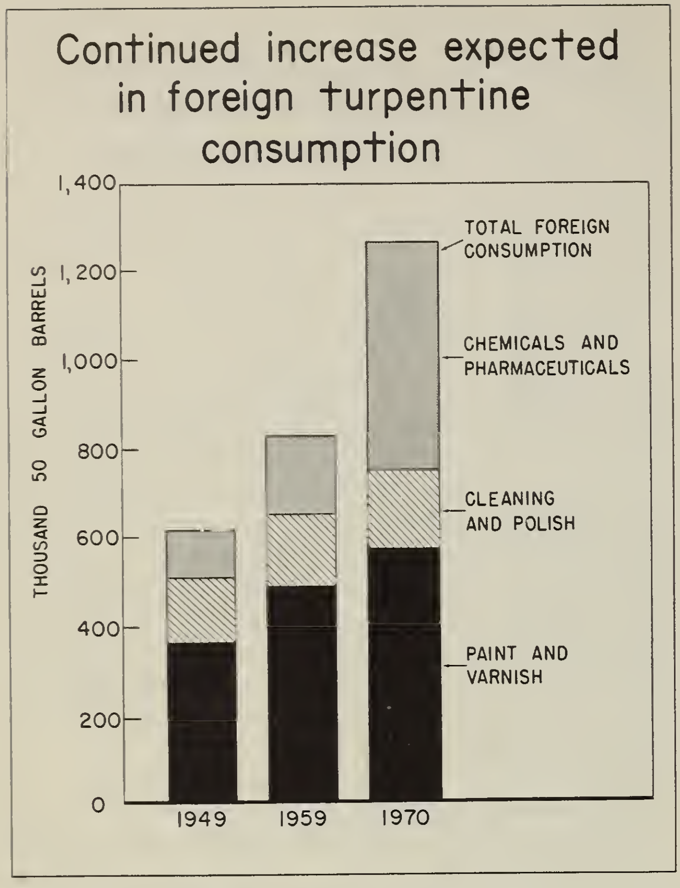

FIGURE 55

paint thinning. Since the total requirement for paint thinner (notwithstanding the wide swath cut in the oil-based paint market by water-based substitutes) is many times as great as turpentine production, the limiting factor in turpentine disposal is competition from lower priced substitutes rather than potential outlets. Most paint thinner is used in the manufacture of ready-mixed oil based paints rather than for application by individual painters and householders. In nearly all foreign countries this ready-mixed paint market long ago was largely taken over by petroleum thinners which were obtainable at a fraction of the cost of turpentine. Recently, however, turpentine prices have declined to the point where in some countries such as Spain turpentine now is cheaper than imported mineral spirits. Nevertheless, prospects for turpentine recapturing any substantial part of the ready-mixed paint market are dim as long as petroleum thinners are generally available at current prices.

Use of turpentine for paint thinning purposes, mainly through retail sales, will continue to be an important foreign outlet for turpentine. However, future growth in foreign turpentine consumption will depend on industrial application of turpentine fractions in products such as cleaners and disinfectants (synthetic pine oil), insecticides, synthetic camphor, and oil additives. If lower price levels of the past year are maintained, as expected, current industrial uses probably will be expanded and new uses developed. Many current turpentine uses were hardly envisaged in the early postwar years, and similar developments are likely in the future. With the assumed low price level, it is conceivable that by 1970 the present utilization pattern will be substantially changed.

Export Market for U.S. Rosin in 1970—540,000 Drums

Projections of foreign rosin production and consumption developed under assumptions stated in the foregoing discussion approximated 3,060,000 and 3,600,000 drums, respectively. Foreign rosin requirements from the United States in 1970 thus would total 540,000 drums. This would roughly equal the volume of average annual rosin exports from the United States since the end of World War II (fig. 56), and would comprise about 25 percent of the total U.S. market for rosin. To the extent that exports of modified rosin (including paper size, rosin soaps, etc.) decline during the decade, exports of rosin are likely to increase and domestic disappearance to decline.

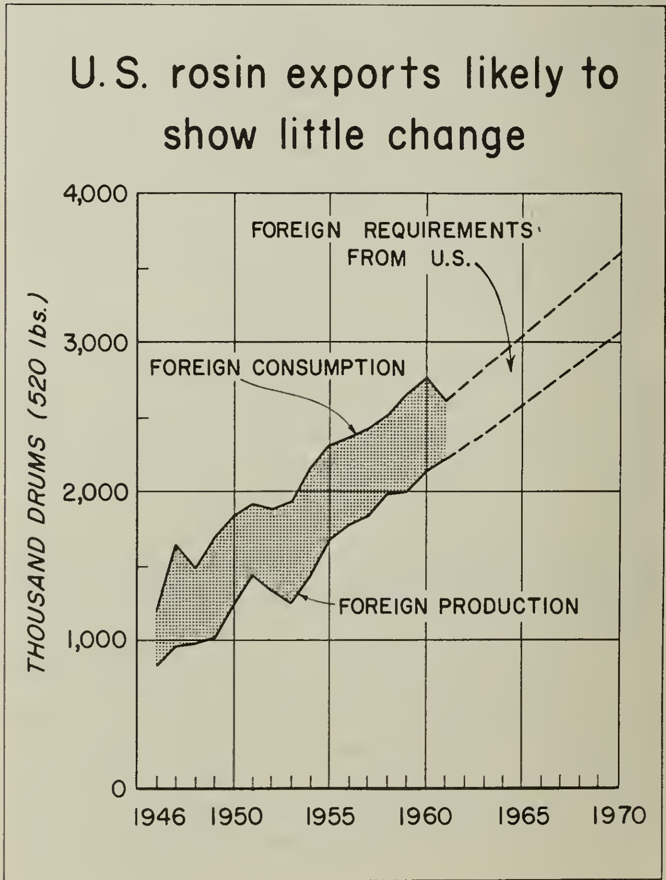

FIGURE 56

Export Market for U.S. Turpentine in 1970—115,000 Barrels

As projected above, foreign turpentine production in 1970 may increase to 1,135,000 barrels, 33 percent more than 1961 output. Foreign consumption in 1970, with assumed price levels, is expected to reach 1,250,000 barrels (fig. 57), an increase of 35 percent over 1961. U.S. supplies are likely to be drawn upon for the difference of 115,000 barrels, which would comprise about 16 percent of the total 1970 market for U.S. turpentine. To the extent that exports of turpentine fractions decline during the decade, exports of turpentine are likely to increase and domestic disappearance to decline.

Little U.S. Tall Oil Will Be Available for Export by 1970

World requirements for tall oil are expected to exceed production. This will likely result in a gradual uptrend in crude tall oil prices. U.S. crude tall oil may not be available for export in substantial quantities except during periods when both tall oil rosin and tall oil fatty acid markets are depressed. Generally, U.S. exports of tall oil during this decade probably will be increasingly confined to its fractions, mainly tall oil rosin and fatty acid tall oil.

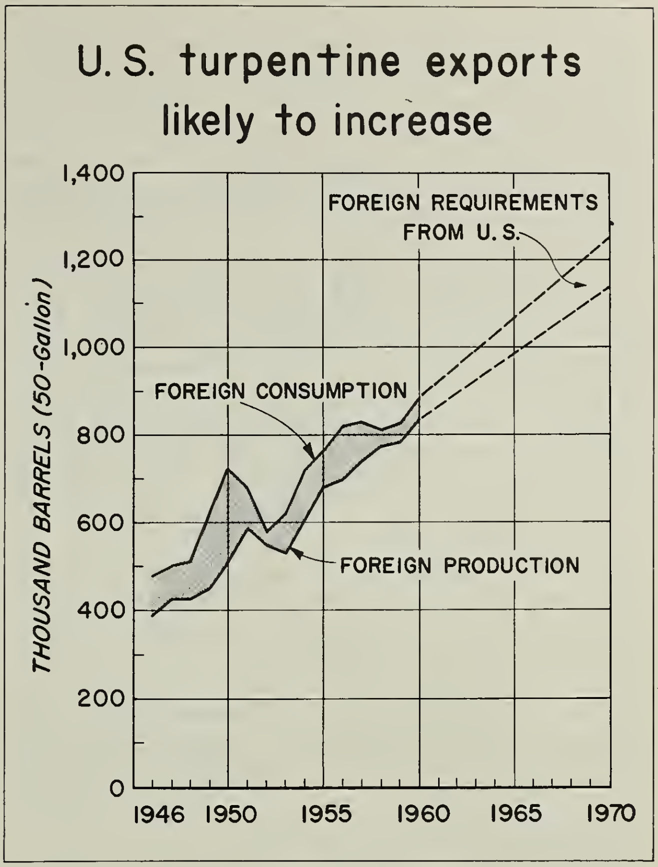

FIGURE 57

PRICE TRENDS AND RELATIONSHIPS

Since naval stores prices depend on production and consumption, both domestic and foreign, and on the all-important influence of the price-support program, a large part of the story regarding factors molding naval stores prices already has been told, although necessarily, in piecemeal fashion. This analysis is intended to draw together the main threads of the story. First, the principal price series used in the analysis are described and appraised. We next consider long-term shifts that have occurred in domestic rosin and turpentine values. Trends in domestic prices of rosin, turpentine, and crude pine gum are then discussed. Prices are examined in relation to supply-demand patterns, price-support activity, and the general price level of all commodities. Finally, domestic prices are compared by sources (gum, steam distilled, and sulfate) and with foreign prices by exporting countries.

Price Information From Several Sources Used

Principal price series—Savannah Cotton and Naval Stores Exchange.—Until the late 1930's, the Savannah Cotton and Naval Stores Exchange, Savannah, Ga., was the world's leading naval stores market. Gum rosin and gum turpentine prices quoted on the Savannah Exchange represented primary sales of naval stores in the United States, and were considered, both domestically and abroad, the principal guideposts to supply and demand conditions.

The decline of the Savannah Exchange as a naval stores pricing medium began in the late 1930's, coincident with the revolution in processing of gum naval stores. By the late 1940's, thousands of producer-owned fire stills had been supplanted by a few central processing plants. The primary market shifted to the central processing plants, which purchased crude pine gum directly from producers, and sold processed gum naval stores (principally rosin and turpentine) directly to domestic consumers, dealers, and exporters. Nevertheless, in the absence of a more representative pricing medium, Savannah Exchange price quotations continued to be used extensively until the establishment, in November 1950, of the Naval Stores Market News Service within the U.S. Department of Agriculture.

Naval Stores Market News Service.—The Naval Stores Market News Service publishes prices *paid* by central processing plants to gum farmers for crude pine gum and prices *received* for processed rosin and turpentine at the central

processing plants. The annual prices used here are averages, weighted by sales volume, of domestic sales transactions of rosin in drums and turpentine in tank cars reported to the Market News Service by processors and other dealers in U.S. gum naval stores. Since its inception, the Market News Service has provided the most representative market information available to the naval stores trade.

Wood rosin and turpentine prices related to gum naval stores prices.—Wood naval stores prices historically have been based on (and usually discounted from) gum naval stores prices. Primary prices (f.o.b. works) were not published regularly until 1946 and 1947 in the case of steam-distilled wood rosin and wood turpentine, and 1955 in the case of tall oil rosin. Primary prices of crude sulfate wood turpentine have not heretofore been published.

Whereas U.S. gum naval stores price quotations always have represented actual (if in earlier times, only token) sales transactions, published wood naval stores prices represent the offering prices, or price ranges, of a few of the leading manufacturers. They may not necessarily be related to actual sales transactions. Prices of crude sulfate turpentine are obtained directly from private trade organizations, but are not necessarily fully representative of actual sales.

Rosin and turpentine prices on the London market.—Comparative "c.i.f. London" prices of rosin were published in both United Kingdom and United States trade journals until September 1939. Thereafter, for about 10 years, naval stores prices in the United Kingdom were controlled by the Government. The c.i.f. quotations since March 1949 used herein were made available by a private trade organization. As in the case of U.S. wood naval stores, rosin and turpentine prices on the London market are offering prices, not necessarily related to actual sales transactions.

Relative Values of Rosin and Turpentine Have Shifted Since 1930

A fundamental shift has occurred over the years between comparative rosin and turpentine values. Up to 1907, U.S. gum farmers derived more income from turpentine than from rosin. Since then the reverse has been increasingly true, and today turpentine has become virtually a byproduct of rosin production. This trend is strongly evident even in the three decades covered by this study. Whereas 30 years ago, gum rosin and gum turpentine contributed about equally to naval stores income, in 1961 their relative contribution was in the ration of 16 to 1.

This reversal in the fortunes of the two leading naval stores products stems principally from basic changes in their demand and supply patterns. Rsin, a low-priced chemical raw material, has benefited pricewise from the development of new uses and diversification of consumption patterns. On the other hand, turpentine, the original paint thinner, has for decades (until the recent turpentine price decline) waged a tenacious though losing merchandising battle against much cheaper substitute solvents, for possession of a market tied to the relatively static output of oil-based paints. Pressure on turpentine prices mounted from year to year as turpentine exports declined and domestic consumption depended increasingly on low-price industrial outlets.

Gum Rosin Prices Have Trended Upward Over the Past Three Decades

In general, the trend since 1930 has been upward, outpacing the BLS Wholesale Price Index (fig. 58 and table 34). The trend, stated in terms of constant 1961 dollars, is shown in figure 59.[20] During the early 1930's rosin prices reflected the reduced level of industrial activity. In 1932 the price of rosin declined to $1.23 per 100 pounds, the lowest level since 1903. This culminated the downward course in rosin prices beginning in 1920 which reflected a gradual curtailment of exports in the face of expanding foreign output. Domestic utilization was relatively static. The price rise in

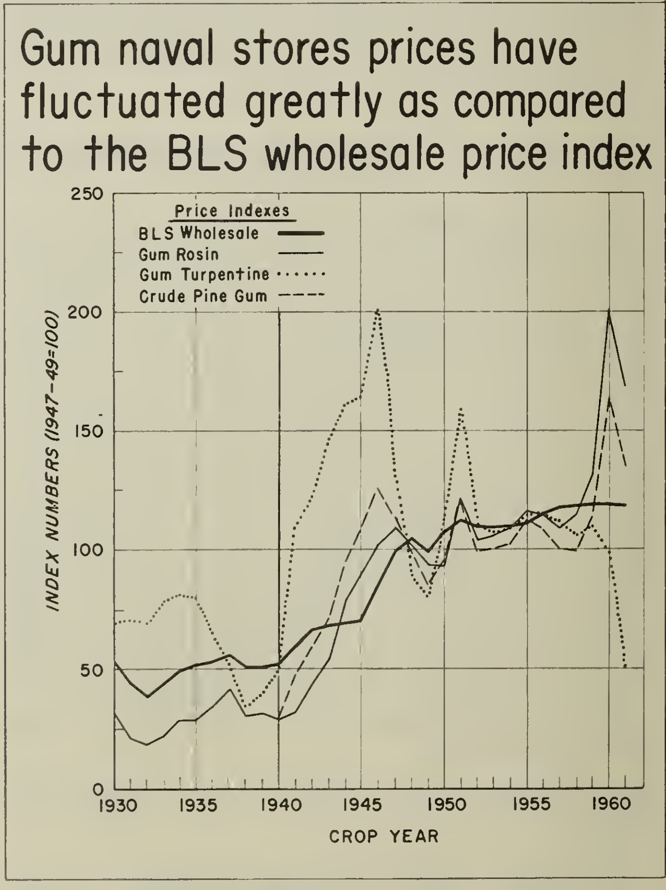

FIGURE 58

[20] The BLS Wholesale Price Index (all commodities), based on 1961, is used as the price deflator.

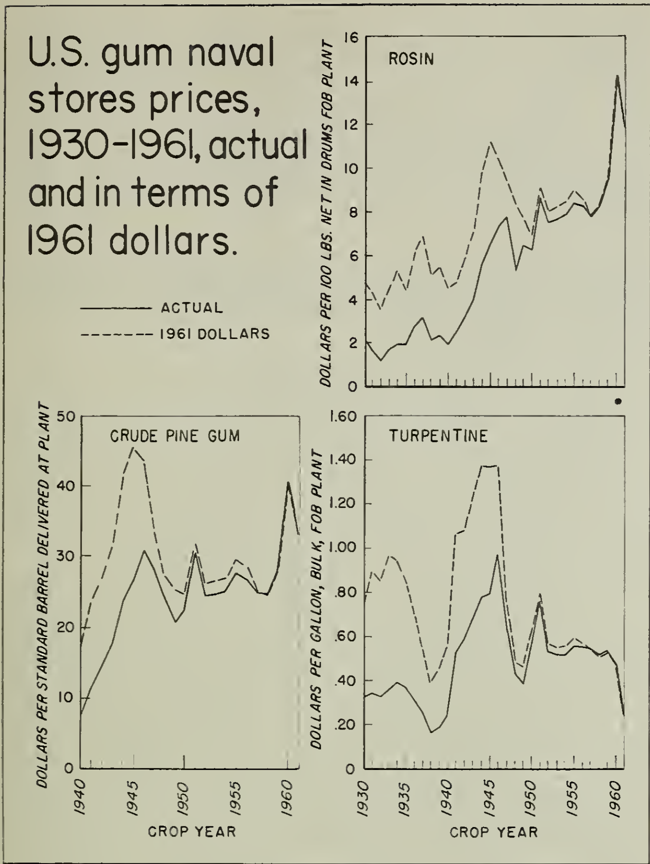

Figure 59

1934 reflected initiation of the CCC price-support program which siphoned 150,000 drums from open-market channels in order to maintain the support level. Similarly, prices were maintained at or near loan levels during 1938–40 through the net acquisition by CCC of 1.159 million drums of rosin. About 540,000 drums were sold by CCC in 1941 when war-fed domestic consumption surged to a new high.

In 1942 rosin prices rose in accord with CCC's attempt to encourage production through higher support rates. Prices continued to rise sharply in 1943 and 1944, coincident with heavy CCC sales activity, until price-support stocks were virtually exhausted in 1944. Thereafter, price ceilings (which would have been established earlier except for the fact that CCC liquidations controlled the price rise) were imposed to prevent runaway prices.

By 1947, the price of gum rosin averaged $7.83, up more than sixfold from the 1932 level. These higher prices stimulated production of both gum and wood rosin and CCC again was called on to prevent precipitous price declines in 1948 and 1949 by acquiring about three-quarters of a million drums of rosin. Most of this rosin was needed in 1950 to meet the unprecedented scare buying demand unleashed by the war in Korea. Much of the rosin sold by CCC at that time went into increased inventories, particularly in foreign importing countries. Once it became apparent that the Korean war likely would be localized, these inflated consumer inventories were absorbed in 1952 with resulting substantial curtailment of export demand, notwithstanding an 8-percent reduction in foreign output. The downward pressure on prices was relieved and prices were maintained at loan value in 1952 through the net acquisition by CCC of 44 percent of gum rosin production.

The post-Korean naval stores adjustment extended well into the 1953 producing season. However, because of a further 6-percent reduction in 1953 foreign output compounded by reduced consumer stocks, U.S. exports increased 45 percent and CCC needed to acquire only 13 percent of a shrinking gum rosin crop in order to maintain rosin prices at the support level.

Both domestic production and consumption of rosin rose in the midfifties. Although foreign production increased steadily during 1954–59, growth in foreign consumption exceeded that in foreign output. Consequently, carryout inventories, both private and CCC, gradually declined at an average rate of about 5 percent annually between 1953 and 1958, while prices stabilized within an annual average range of $7.90 to $8.45 per 100 pounds.

This relatively small-scale ebbing of inventories erupted in 1959 into a tremendous surge of buying and all CCC rosin stocks were sold at progressively rising prices in the face of increased domestic and record foreign consumption. CCC sales prices (basis WG grade) during this culminating phase of sales operations ranged from $8.30 in April 1959 to $10.65 in January 1960. The exhaustion of CCC rosin stocks unleashed all restraint and prices soared to the unprecedented high of $17 in the late summer and fall of 1960, the 1960–61 recession notwithstanding. By late fall of 1960, inventories accumulated by domestic and foreign consumers, together with increased domestic and foreign production (stimulated by the higher prices), began adversely to affect the market. Chemical companies intensified work on rosin substitutes and virtually all consumers, who could economically do so, shifted to fortified paper size. Rosin prices turned downward and were stabilized at about $12 during 1961 (about 30 percent below the 1960 peak) primarily through utilization of the support program by the producer-membership of the American Turpentine Farmers Association Cooperative. About 112,000 drums of processed rosin, nearly one-fourth of gum rosin output, and about 5 percent of the domestic production of all types of rosin, were in CCC hands at the end of the crop year, subject to redemption.

Although reduced world production is expected in 1962, the decline will be more than offset by a record foreign carryover from 1961. Under these circumstances, and notwithstanding a likely increase in world consumption, rosin prices are likely

to be lower in 1962. The decline in domestic gum rosin prices will be checked by the CCC price-support rate of $10.50 (basis WG) and the consequent pledging of more than half of the gum rosin output to the 1962 loan.

Turpentine Prices Have Declined

The peak price of gum turpentine was reached in March 1920, when prices averaged $2.07 per gallon, 11 times the average price for June 1962. (Stated in terms of constant dollars, the disparity would be greater.) Gum turpentine prices were at their peak during 1919–26, years of extraordinary price fluctuations. Thereafter, prices reflecting increased competition from low-priced substitute solvents trended downward, reaching an alltime low of 15 cents per gallon in September 1938 and an average of 16.6 cents per gallon for the entire crop year. Very likely the price would have been lower but for the CCC price-support program which absorbed 145,000 barrels of turpentine, net. The weak market resulted from a near record domestic output coincident with a business recession and a 24-percent reduction in the all-important export market.

During 1939 through 1941 prices increased, and they rose above support level in 1940 and 1941. Higher disappearance combined with lower domestic production to permit CCC to liquidate all of its turpentine stocks during this period. Prices continued to increase in 1942 and 1943 because of higher price-support rates and acquisition by CCC of half the 1942 gum turpentine crop and one-fourth of 1943 output. Disappearance substantially exceeded production in each of the following 3 years and CCC once again sold out of turpentine stocks at rising prices. Because of CCC sales operations, price ceilings were not needed or established on gum turpentine until 1946. Following decontrol on November 9, 1946, the price of gum turpentine soared to $1.50 per gallon in 5 days of trading over the Savannah Exchange. However, the extreme shortage and high prices of 1946 had seriously curtailed turpentine consumption. Prices subsequently declined, the recession gathering momentum from substantially increased production and reduced domestic and export requirements in 1947. The price decline halted at loan value (60.8 cents per gallon), with CCC acquiring about 18 percent of gum turpentine output.

Turpentine was not moving into consumption at the loan rate level and in June 1948 the support rate was reduced to 40 cents. At this lower price level, an increased volume of turpentine moved at retail in small containers. Prices stabilized at about 40 cents until emergency requirements accompanying hostilities in Korea permitted CCC to liquidate nearly all of its stocks at rising prices prior to imposition of price ceilings in 1951.

However, the spurt in demand was temporary and prices in 1952 receded to the 50-cent loan level and stabilized there for 9 years. During this period, domestic demand for turpentine continued to shift from retail to lower priced industrial outlets. The factors immediately involved in the weakening of the turpentine market in 1960 and the subsequent collapse of turpentine prices were described earlier in the discussion of foreign consumption.

Crude Pine Gum Prices Reflect Market Returns for Rosin and Turpentine Content of the Gum

The net amount paid to producers for a barrel of gum is determined by (1) the quantities of rosin and turpentine estimated by the processor to be contained in the gum; (2) the estimated grade of the rosin content of the gum; (3) the current market value of processed rosin and turpentine; and (4) the processor's margin.

A standard barrel of crude pine gum weighs about 435 pounds net and contains approximately 310 pounds of rosin and 10 gallons of turpentine. The processor's margin is influenced by a number of factors, including the size of the crop in relation to processing capacity and the price level of rosin and turpentine. In general, the margin reflects competition between plants. Each processor tends to pay the price which will attract the supply needed for his operations. Over and above this general competition, margins tend to rise and fall with the value of rosin and turpentine content and, on the whole, move counter to the size of the gum crop. When the crop increases, plants operate more efficiently and closer to capacity and, assuming equality of other factors, margins tend to be reduced. When the crop shrinks, the reverse is true and processing margins may increase, depending on the relative impact of increased processing costs and increased competition for the reduced gum supply.

Because the rosin content of the gum is far more valuable than the turpentine in it, crude gum prices tend to rise and fall with rosin prices. The trend of crude pine gum prices since 1940 is not as markedly upward as in the case of rosin prices for two obvious reasons. First, gum turpentine values have trended downward and, second, processing margins have risen substantially. When crude gum prices are stated in terms of constant dollars, the trend appears inconclusive (fig. 59) and the "unprecedented" prices received by gum farmers in 1960 are exceeded by the price levels of 1944–46.

Changes in Average Inventories Are Related Inversely to Price Changes

Changes in rosin and turpentine prices mirror changes in the basic conditions of demand and supply for these commodities. Changes in fundamental demand and supply factors, in turn, are generally evidenced by variations in stock levels.

During the period 1930–61, rosin and turpentine prices generally moved counter to the average inventory level in each crop year (fig. 60). Exceptions in the case of rosin were the 8 years, 1934, 1935, 1937, 1939, 1950, 1953, 1956, and 1957. Most of these exceptions resulted from price-support activity. In 1934, 1935, and 1939, price-support action substantially altered rosin price levels as did CCC competitive-bid export sales operations in 1956 and 1957. In 1950, the exception clearly was related to the paucity of trading over the Savannah Exchange during a period of rising prices. Thus, the average market price for 1950 computed from Savannah Exchange quotations substantially understates the actual price level. There were 11 exceptions in the case of turpentine—1931, 1934, 1937, 1942, 1943, 1951, 1953, and 1956–59. In several instances, the exceptions resulted from price-support activity (1934, and 1942–43), but during 1956–59 the exceptions were due to the fact that changes in stored stocks of processed turpentine only partially reflect basic demand-supply conditions for turpentine. Since the mid-1950's there has been a shift from storage of processed gum rosin and turpentine to storage of crude pine gum. In this regard, an increasing quantity of turpentine was needed to dilute growing stocks of crude pine gum. This turpentine was not consumed; but rather was recovered when the gum was processed. Moreover, as industrial consumption of turpentine increased in the 1950's an increasing volume of turpentine was stored in the form of turpentine fractions.

Changes in demand and supply as reflected in stock variations account for most changes in rosin and turpentine prices.

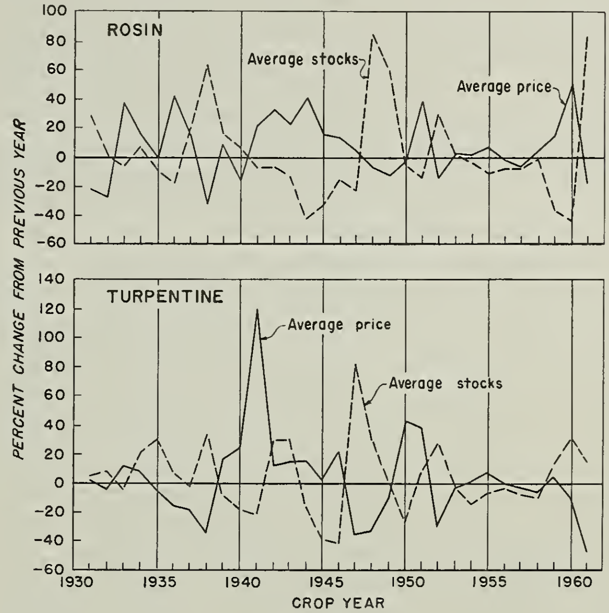

Figure 60

Price-Support Program Has Stabilized Prices

By constituting a competing demand for gum naval stores when collateral is placed in the loan or purchased, and a competing source of supply when stocks are sold or redeemed, the price-support program has profoundly affected the demand for and supply of naval stores. These competing demand and supply activities, together with the price floor established for gum naval stores, inevitably affected to a varying extent all types of naval stores and foreign as well as domestic production. Moreover, operation of the naval stores price-support program has contributed significantly to price stabilization in commodities formerly characterized by extreme price fluctuations. The market effects of the support program were more fully described in a preceding section. (See p. 15.)

Gum Naval Stores Prices Have Fluctuated More Than Those of All Commodities

In addition to reflecting supply and demand conditions which, as has been demonstrated, are partly molded by the price-support program, naval stores prices also reflect the ups and downs of business conditions.

Rosin, turpentine, and crude pine gum prices, in fact, show considerably greater fluctuation than the general price level, as represented by the BLS Index of Wholesale Prices, All Commodities (fig. 58).[21] From 1930 through 1961 the BLS index changed an average of 6 percent annually compared with 18 percent for rosin, 19 percent for turpentine, and (from 1940 to 1961) 17 percent for crude pine gum. Maximum changes were increases of 22 percent in the BLS index from 1946 to 1947, 51 percent in the price of gum rosin from 1959 to 1960, and 120 and 59 percent in the prices of gum turpentine and crude pine gum, respectively, between 1940 and 1941.

Changes in the general level of prices result from alterations in basic relationships between purchasing power, availability of goods, and monetary supplies which similarly affect all commodity prices. The wider fluctuations of naval stores prices as compared with the general price level result from the relatively inelastic demand which rosin and turpentine have in common with many agricultural commodities. Under inelastic market

[21] For convenience of comparison, gum rosin, gum turpentine, and crude pine gum prices have been converted to an index using the same base (1947–49=100) as the BLS Wholesale Price Index.

conditions, a given percentage reduction in requirements or increase in supply generates a proportionately greater decline in price. Moreover, gum naval stores producers cannot readily accommodate their output to short-term market changes. When demand declines, they are unable easily to curtail operations because of the sizable investment in timber, leased or owned, and the tendency of laborers to accept lower wages in preference to unemployment. On the other hand, during periods of strong demand (World Wars I and II, the Korean war, and during 1959–60) output cannot readily be expanded. In fact, during war, production usually is curtailed primarily because labor is siphoned off to the armed services and to more remunerative occupations.

Gum naval stores prices have tended to move in the same direction as the general price level. Since 1930, gum rosin and gum turpentine prices have followed the same trend as the BLS index about three-fourths and two-thirds of the time, respectively. Similarly, since 1940, the price of crude pine gum has moved in conformity with the BLS index more than two-thirds of the time. Years of contrary movement resulted from fundamental demand-supply conditions peculiar to the commodities, including price-support influences.

Excluding the extreme years (1940–41, 1944–46, and 1960–61), rosin prices since 1940 have increased slightly, turpentine prices have declined substantially, and prices of crude pine gum have declined slightly, relative to the general price level.

U.S. Prices of All Types of Naval Stores Correspond Closely

Up to about two decades ago, gum rosin and gum turpentine enjoyed consumer preference and commanded a price premium over steam-distilled wood rosin and turpentine. Actually, prices of steam-distilled wood naval stores were discounted from Savannah Exchange quotations on gum naval stores (*4*). Between 1925 and 1935, prices of steam-distilled wood rosin averaged 7 to 18 percent, and steam-distilled wood turpentine prices 7 to 14 percent, below gum rosin and turpentine.

Much of this preference was lost during World War II. Steam-distilled wood rosin and turpentine price ceilings were established at significantly lower levels than gum rosin and turpentine. These lower priced products consequently were utilized by consumers in preference to gum rosin and turpentine. It happened that demand was so strong as to clear the market of practically all supplies, but the experience increased the relative popularity of the wood naval stores products, and postwar discounts off gum rosin and turpentine prices were smaller than prewar discounts. From 1946 through 1961, prices of steam-distilled wood rosin and turpentine averaged 1 and 7 percent, respectively, below their gum counterparts (figs. 61 and 62 and table 35). Prices of tall oil rosin averaged 10 percent below gum and 9 percent below steam-distilled wood rosin prices in the period covering the crop years 1955 through 1961. Differentials between tall oil rosin and other rosins ranged from 22–23 percent in 1955 to 2 percent in 1957.

The great bulk of sulfate turpentine is marketed as crude. Prices for the crude, not previously published, are shown in figure 62 and table 35 Since these prices cover unrefined turpentine, sold for industrial consumption rather than retail distribution, they are not directly comparable with prices for gum and steam-distilled wood turpentine. Nevertheless, prices of crude sulfate turpentine generally share the major price movements of refined turpentines. In recent years, however, differentials between the crude and refined turpentines have been narrowing. For example, whereas during the 10 years 1946 through 1955 price differentials between gum turpentine and crude sulfate turpentine averaged 62 percent or 36 cents per gallon, during the past 5 years (1957–61) the differentials averaged 45 percent off gum turpentine prices or 21 cents per gallon.

Although primary prices of refined sulfate turpentine are not available for comparison, quotations on the New York market (as published in the New York Journal of Commerce) indicate that they usually are lower than both gum and

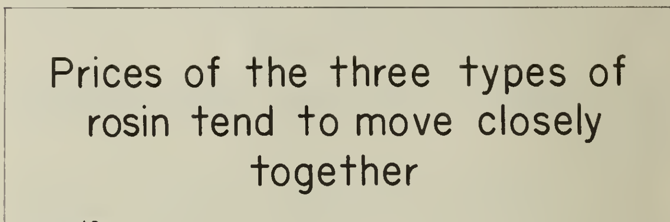

FIGURE 61

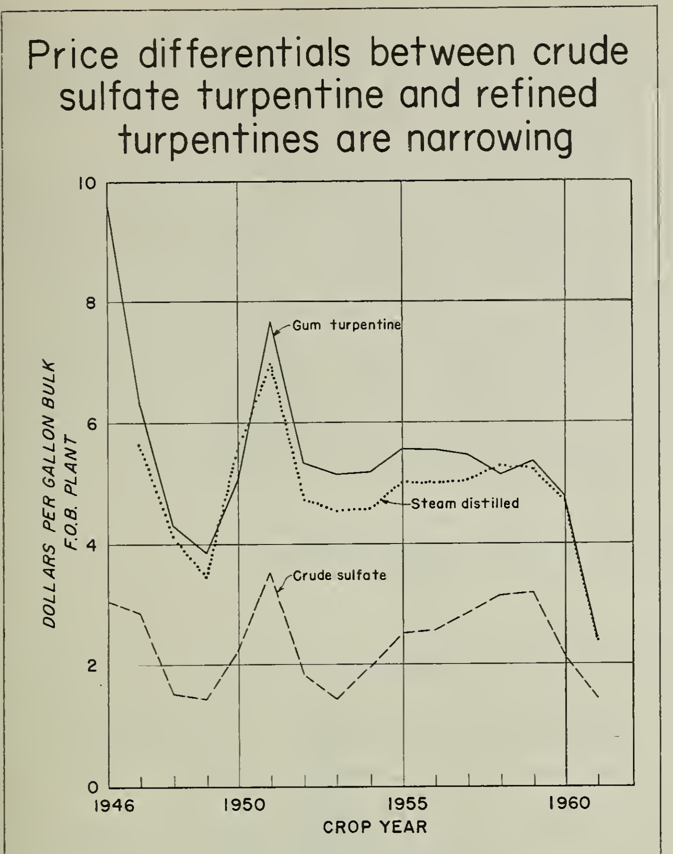

FIGURE 62

Foreign prices also have reflected the major price changes in the domestic U.S. market, although, during the prewar years 1930–39 and since 1951, suppliers of foreign rosin generally have undersold the U.S. product (fig. 63 and table 36). Price cutting has been especially marked in Greek and Sino-Soviet-bloc quotations. However, Greek rosin reportedly has a tendency toward crystallization, and pricing policies of the Sino-Soviet bloc have political aspects. Under collective economies, foreign trade is independent of price, being conducted, it appears, with an eye not to profits or losses on any one commodity or even on foreign trade as a whole, but to the established economic and political requirements and goals.

The spread between United States and other rosin prices on the London market increased in 1962. As of July 6, 1962, based on WW grade, U.S. rosin quotations exceeded those of other exporting countries to the extent of $2.19 in the case of Mexico and France, $2.37 for Portugal, $2.81 for Spain, $3.13 for the U.S.S.R., and $3.50 for Greece. United States and foreign prices on the London market currently average about 23 percent under average levels for the 1961 calendar year. It is reasonably certain that world consumption will not increase by anything resembling this level in 1962. Obviously, under circumstances

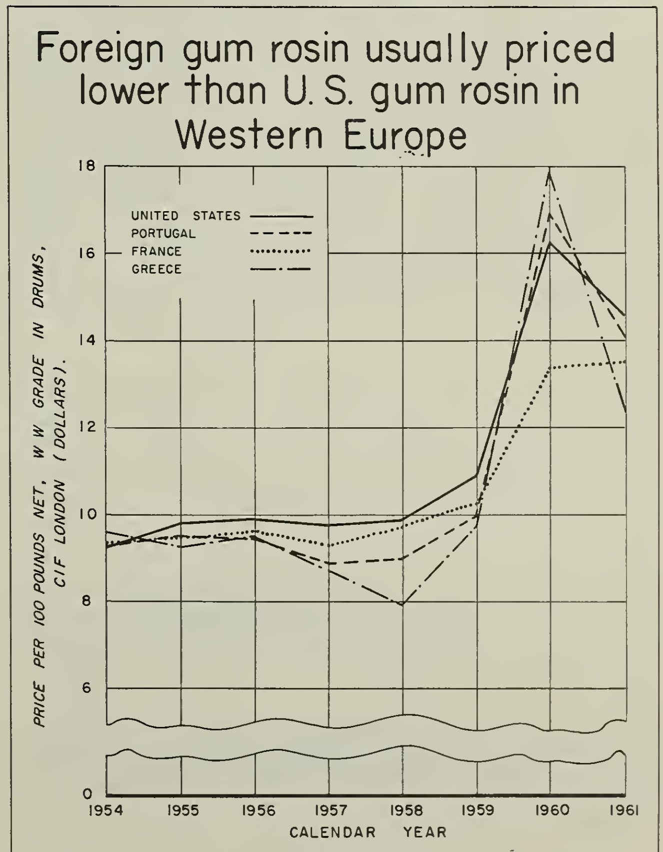

FIGURE 63

steam-distilled wood turpentine. For example, during the 1959 calendar year, New York prices of gum, steam-distilled wood, and refined sulfate turpentine were, respectively, 92, 89, and 79 cents per gallon. During August 1962, New York prices for the three refined turpentines were almost identical.

Foreign Prices Reflect Major Price Changes in Domestic U.S. Market

Immediately after the war, dollar deficits and, since 1952, price competition have relegated the United States to the role of residual supplier of rosin and turpentine to the all-important Western European market. Dollar deficits have long ceased to be a major obstruction to U.S. trade in this area. Price competition, however, has increased, reaching an apex in the case of rosin in 1962.

In general, rosin price quotations on the London market have followed primary prices in the United States closely. Thus, London quotations for U.S. gum rosin averaged 64 to 77 cents per 100 pounds net higher from 1930 through 1939, as compared with U.S. primary prices and $1.27 to $2.30 higher from 1954 through 1961 [22] (table 36).

[22] Rosin prices available on the London market for the period 1949 through 1953 are based on incomplete data and are, on the whole, insufficient for general comparisons.

of supply and requirements prevailing in 1962, world marketing controls would substantially increase returns to the naval stores trade.

In general, the above remarks concerning rosin also are applicable to turpentine. Data on foreign turpentine prices is fragmentary. However, on the London market during the calendar years 1955 through 1959, simple averages of United States, Portuguese, and U.S.S.R. turpentine prices (per gallon ex. Store London) were as follows:

	United States (Dollars)	*Portugal (Dollars)*	*U.S.S.R. (Dollars)*
1955	1.08	1.02	0.96
1956	1.03	1.00	.93
1957	1.08	1.01	1.02
1958	1.06	.98	.96
1959	1.12	.94	.92

The current turpentine situation contrasts with rosin. Turpentine stocks abroad are not excessive, and U.S. gum turpentine prices are competitive with prices of gum turpentine from other sources.

The effect of foreign price competition is apt to be intensified in the 1960's to the extent that the European Common Market erects tariffs against outside suppliers. In this connection, the tariff reduction authority in the Trade Expansion Act of 1962 will provide a tool for negotiating reductions in tariff barriers against naval stores.

On the other hand, the International Commission on Rosin Products recently organized in Western Europe may, if successful, stabilize rosin supplies and prices in that important naval stores area.

THE OUTLOOK FOR NAVAL STORES

In this section we bring together estimates developed in foregoing sections to determine total prospective demand for U.S. naval stores. We also appraise the proportion of U.S. production capability likely to be used in meeting future requirements, and thus indicate the outlook for U.S. naval stores production.

Outlook for U.S. Rosin Demand in 1970—5 Percent Greater Than in 1960

Domestic requirements for rosin in 1970 were previously projected to 1,606,000 drums compared to 1,408,800 in 1960, an increase of 14 percent. Prospective export demand for U.S. rosin in 1970 was projected to 540,000 drums from 627,590 drums in 1960, a decrease of 14 percent, but roughly equal to average annual exports since 1946. Thus, total demand for U.S. rosin is expected to rise to 2,146,000 drums annually by 1970, an increase of 5 percent over the 2,036,390 drums required in 1960 (fig. 64).

Outlook for U.S. Turpentine Demand in 1970—17 Percent Greater Than in 1960

Turpentine requirements for domestic uses were similarly projected from 522,770 barrels in 1960 to 592,000 barrels in 1970. Export demand for U.S. turpentine in 1970 was estimated at 115,000 barrels compared to 81,750 barrels in 1960. Thus, prospective demand for U.S. turpentine in 1970 totals 707,000 barrels, an increase of 17 percent over the 604,520 barrels required in 1960 (fig. 64).

Outlook for U.S. Rosin Production in 1970—Small Increase in Volume, Big Change in Source

About 6 percent more than the 2,009,960 drums of U.S. rosin produced in 1960 will be needed to

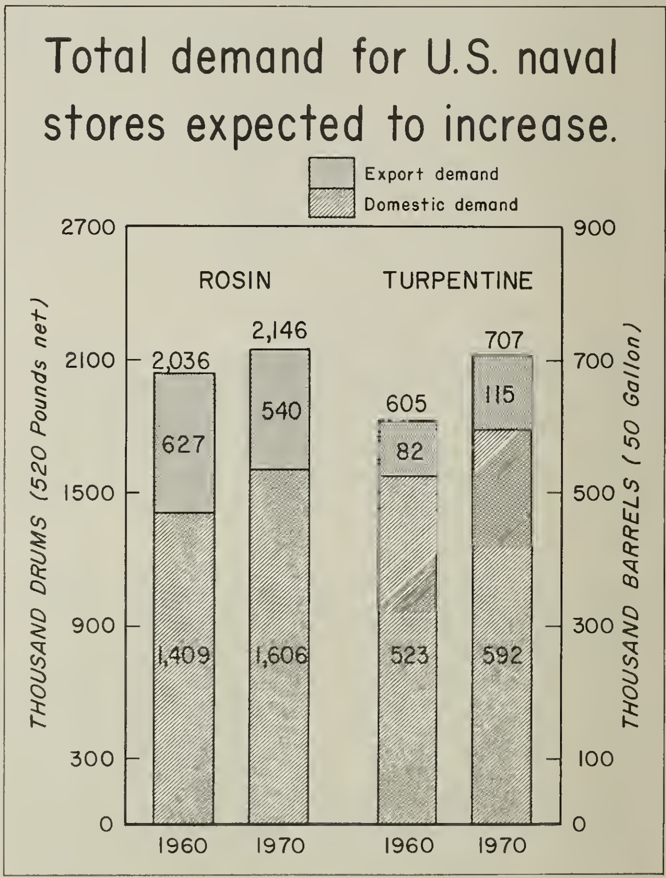

FIGURE 64

meet the projected demand for U.S. rosin of 2,146,000 drums in 1970. Major shifts in sources of domestically produced rosin likely will occur in meeting this prospective demand.

Steam distilled wood rosin production in 1970 is expected to be about 800,000 drums, or one-third less than 1960 production (fig. 65). This estimate is the lower level projection of the industry's production potential discussed previously. (See p.

20.) Here, the primary assumption was that no plants operating today would be relocated, and that each plant would continue to operate near its 1960 level until depletion of stump wood resources in its present main supply areas forced plant closure. As previously shown, the bulk of the remaining stump wood resource is located in Florida and Georgia. Here, many of the most operable stump supply areas have been secured under long-term contracts by plants in these areas, thus limiting possibilities for West Gulf plants to relocate farther east. Furthermore, in view of the limited stump resource, companies now operating in the Southeast are unlikely to build new plants since this would shorten the life of existing plants. Production capability of the stump wood industry thus is expected to decline with successive plant closures caused by depletion of stump wood resources.

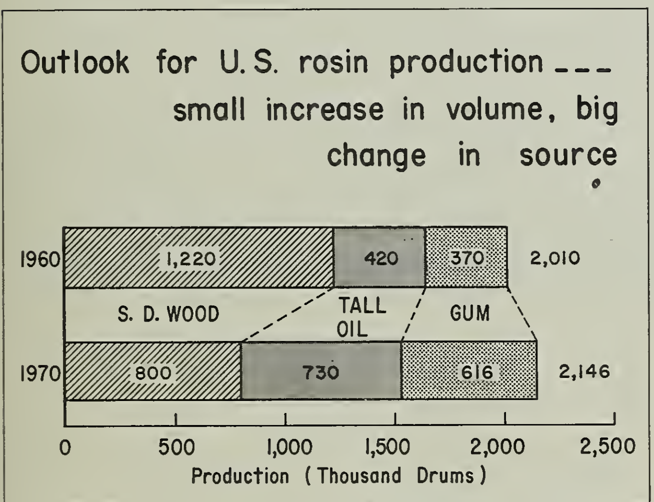

FIGURE 65

Tall oil rosin production in 1970 is expected to reach 730,000 drums, or about 75 percent more than U.S. production in 1960. This projection is the tall oil rosin production potential previously discussed. (See p. 22.) With 21.5 million tons of sulfate pulp produced nationally, production of 1.2 billion pounds of tall oil is anticipated in 1970. Most of this tall oil will be fractionated, except possibly during periods when depressed markets for the fractions, tall oil and fatty acids, make the sale of refined tall oil more profitable. Assuming that 90 percent of the tall oil available in 1970 is fractionated, and that 35 percent by weight of this is isolated as rosin, 730,000 drums of tall oil rosin will likely be produced.

Gum rosin production must then be increased to 616,000 drums in 1970, if the potential demands for U.S. rosin are to be met. This would be 65 percent more than the 370,150 drums of gum rosin produced in 1960.

Outlook for U.S. Turpentine Production in 1970—43 Percent More Than 1960

Turpentine production in the United States will likely reach a level of 866,000 barrels in 1970, if the above outlook for rosin production materializes. This would be 43 percent more than the 604,770 barrels produced in 1960.

Gum and steam distilled wood naval stores production is keyed to the demands for rosin, which accounts for most of the total value of all naval stores output combined. With the price relationships in 1960, for example, rosin accounted for 87 percent and turpentine for 6 percent of the total value of all primary naval stores products domestically produced. With 1961 prices, the value of rosin produced exceeded that of turpentine by 16 to 1. Turpentine, therefore, can be considered a byproduct with gum and steam distilled wood output controlled by demands for rosin, and sulfate output controlled by the demand for kraft paper.

The 43-percent increase in 1970 turpentine production anticipated with only a 6-percent increase in rosin production is due to the shift expected among sources. The yield of turpentine per unit of rosin produced is much less from steam distilled wood than from gum or sulfate sources. With a decline in steam distilled wood naval stores production more than offset by increased production of sulfate and gum naval stores, the overall output of turpentine per unit of rosin produced in 1970 will be substantially greater than at present.

With 1960 yields of turpentine per unit of rosin produced by each of the three segments of the industry, the projected 1970 level of rosin production would be accompanied by an output of 866,000 barrels of turpentine (fig. 66). Such a turpentine output would exceed projected demand (707,000 barrels) for U.S. turpentine by about 160,000 barrels indicating substantial supplies for possible new or expanded uses beyond those visualized in this analysis.

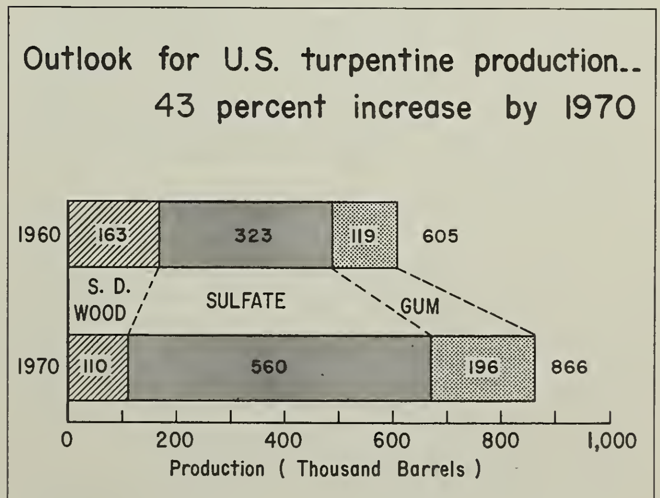

FIGURE 66

OPPORTUNITIES FOR FUTURE NAVAL STORES RESEARCH

Future growth of the naval stores industry will depend greatly on the future development of more efficient production techniques that will provide dependable supplies of naval stores products at stabilized and competitive prices for present markets, and of chemical or physical modifications of existing products and new intermediate chemicals for formulation of additional products that will provide new markets. Large expenditures for research have been invested in development of the present industry. Further growth and development, or even maintaining the present position of naval stores in the keenly competitive chemical field, will require continuing research.

Research Has Been Essential in Development of the Naval Stores Industry

Much utilization research has been required in developing the naval stores products now being marketed. Many products such as hydrogenated rosin, polymerized rosin, zinc resinates, rosin dimers, terpene hydroperoxides, and synthetic pine oils are the results of intensive utilization research in the field of terpene and rosin chemistry.

Much research on production methods and techniques also was required in developing the isolation and purification schemes used in extracting and processing steam distilled wood and sulfate naval stores.

The very existence of the gum naval stores industry today is attributed by many to reduced gum production costs and increased yields made possible by past research. Improved gum extraction methods and application techniques (*10*) developed by research have reduced labor expenditures per unit of gum production by as much as one-half of that formerly required, with increased gum yields of as much as 20 percent.

Additional gains are possible through more thorough field application of existing knowledge. Research has determined and outlined for commercial use many of the major factors which influence gum flow. With consistent and widespread use of modern extraction methods based on these known factors, the average gum yield per crop today probably could be further increased as much as 15 percent.

Genetics research in the past also has been productive, but tangible benefits to the gum industry will not be realized until several more decades have passed. The Forest Service at the Lake City Research Center in Florida has developed a high gum-yielding strain of slash pine. According to research results, pines of this strain should produce twice the normal yield of gum, with corresponding reductions in production costs.

Two seed orchards were established in 1959 using clonal material from these high-yielding trees. One is a small U.S. Forest Service experimental orchard 4 acres in size, located near Lake City, Fla. (fig. 67). The other is a 35-acre orchard established by the Georgia Forestry Commission near Macon, Ga. A third seed orchard is currently being established by the St. Regis Pulp & Paper Company near Lee, Fla., and a fourth is being planned by the Florida Forest Service.

These orchards must grow for at least 15 years before they will produce sufficient seed to make feasible nursery production of seedlings. Then another 15 years must pass before these field-planted seedlings can grow large enough for gum production. Additional orchards and more time will be needed to grow enough such stands to produce significant volumes of gum. Thus, 40 to 50 years may pass before these high gum-yielding pines have major impact on U.S. gum production.

Many Promising Opportunities Exist for Future Research

Gum production.—Basic physiological research to determine the biochemical processes by which oleoresin is synthesized within the tree should be given high priority in future gum production research. A complete understanding of these biochemical processes might suggest entirely new methods of extracting gum from the tree. Also, this basic knowledge would guide more effective testing of chemicals to use as gum flow stimulants, as well as chemicals that could cause the trees to synthesize greater amounts of gum. Cultural measures for improving gum yield such as fertilization, cultivation, and irrigation could be more thoroughly explored.

Additional genetics research could provide substantial long-term benefits. Future genetics research in the Southeast should aim at development of improved strains of trees which combine other desirable traits, such as superior growth rate and specific gravity, with high gum yield. The existing high gum-yielding strain also should be expanded by obtaining more proven selections.

New research in naval stores production techniques should be aimed at the problem of maintaining or increasing gum yield while reducing manpower requirements. Development of improved field labor organization such as squad systems or other labor patterns for gum production offers possibilities for increasing productivity and reducing costs, especially in well-stocked pine plantations. The most promising approach appears to be through development of new procedures that will reduce the number of tree visits per barrel of gum produced. Development of new chipping or chemical stimulation techniques might lengthen the period of gum flow without the corrosive effect of sulfuric acid on cups and gutters. One effective noncorrosive chemical is a 2-percent

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FIGURE 67.—A seed orchard of high gum-yielding slash pine developed by genetics research. Offspring of these trees are expected to yield more than twice as much gum as average wild trees.

solution of 2,4-D (*18* and *21*) which shows promise on slash pines, but kills longleaf pine. Tests of numerous other growth-regulating chemicals now available may reveal one which will prolong gum flow from both slash and longleaf pines. If the 2-week gum flow generally obtained with current practices could be extended to 3 weeks, labor requirements for chipping could be reduced by one-third.

New developments in gum cups or containers might materially reduce the labor required for dipping and collecting gum. Satisfactory disposable containers might bring a significant improvement in gum quality as well as make gum collection easier and less costly.

New or improved types of motorized equipment might be developed to increase the efficiency of dipping procedures. Mechanical chippers do not offer much promise because with present methods a skilled chipper can put on a streak in a matter of seconds. As gum production is shifted from natural forests to plantation stands with rows of even-sized trees, other opportunities for mechanization may develop.

Economic studies on pilot-scale operations are needed to determine relationships between gum and timber production under various stand conditions. Low-density plantations or gum orchards of widely spaced trees with large crowns and large diameters could produce high gum yields with minimum labor requirements, where gum production is the primary objective. On the other hand, where growth of wood is the primary objective, diameter and crown ratio of trees are reduced by density of stands, and gum yields are less. More and better data are needed regarding per-acre volume growth, diameter growth, and diameter distribution of timber at various densities and ages on different sites. Gum yields need to be correlated with these growth data so that proper combinations of gum and timber products can be produced to meet various landowner objectives.

Additional research is needed on control of diseases and insects associated with naval stores operations. Improved remedial and preventive measures could be developed that would be more effective, economical, and applicable under all stand conditions than those presently available. Insect and disease problems generally are increased by extensive plantings of single species, off-site plantings, and even-aged management of

forests. Such forests will become increasingly important in supplying future gum requirements. Gum extraction procedures and silvicultural practices probably will be intensified with greater mechanization of woods operations which could increase hazards from insects and disease. And, finally, insects affecting pine seed production and forest pests which threaten young pine plantations should be studied more thoroughly to protect the large investments of time and money that will be required in establishing and maintaining the high gum-yielding seed orchards and plantations of the future.

Utilization research.—There are no new products or processes, other than terpene resins, known to be ready for commercialization that are likely to provide significant new markets for rosin or turpentine in the immediate future. There are, however, opportunities for utilization research that could lead to important new uses.

New modifications of rosin that might provide additional markets should be given emphasis in future rosin utilization research. One promising approach, for example, is the light catalyzed oxidation of rosin in the presence of dyestuffs. This reaction yields peroxides which can be converted into resin acids containing tertiary hydroxal and ketone groups. Another possibility is production of new chemicals from rosin through hydroxylation of rosin with hypohalites. Through addition of beta-propiolactone an additional carboxyl group can be introduced. From such dibasic rosin, high polymers, and high molecular weight polyesters can be derived.

As new basic chemicals are developed from rosin, much effort should be devoted to determination of fundamental properties and commercial potentials of logical derivatives. Basic use characteristics such as adhesion, rigidity, and color development should be determined before engaging in extensive development of specific applications. Because of the intense competition in the chemical field, the inherent properties of new chemicals must be fully probed and relationships determined between properties and likely cost.

Improved paper size is another possibility. Levopimaric acid obtainable from gum oleoresin is more resistant to oxidation than other resin acids. Paper size made from this might show less color degradation than ordinary rosin sizes. If its performance approached that of stabilized rosins in sizes, research in this area might produce economical improved sizes. Rosin isocyanate offers another possibility. Although it reportedly reacts slowly with hydroxyl groups, with use of suitable catalysts it might be made to react with cellulose in paper resulting in a chemically combined rosin size on paper quite different from ordinary rosin sizes.

Turpentine derivatives might be developed for extending rosin paper sizes. Interest in possible use of competing materials for part of the rosin used in paper sizing is great. One substitute being considered is petroleum olefin derived resins which are emulsified with rosin soap. Possible use of resins derived from turpentine in place of petroleum source material should be explored. The main components of turpentine, alpha-pinene, beta-pinene and dipentene can be polymerized to resins. Conceivably some or mixtures of these hydrophobic hydrocarbon resins derived from turpentine could be used for paper size employing rosin size as an emulsifier. If successful, this might provide a major outlet for surplus turpentine, and help stabilize rosin prices as well. Such resins might also be useful in other products such as adhesives and paper coatings.

Beta-pinene currently is being polymerized to a commercial resin. Beta-pinene is in short supply and would provide an outlet for appreciably more turpentine if markets could be developed for the additional alpha-pinene resulting from increased beta-pinene production. Increased use of alpha-pinene for paper size was discussed above. Another possibility is the catalytic conversion of alpha-pinene to beta-pinene. Boranes have been reported to be effective catalysts, and less expensive catalysts might be found. Techniques for the polymerization of alpha-pinene to resins of possible commercial use are not adequately understood. The shortcomings of such resins that have been developed are their low melting point and the costs associated with catalyst requirements. Additional research in this area might lead to expanded markets for turpentine.

Improved analytical procedures and methodology should be developed which will make possible more precise chemical analyses of mixtures of resin acids, fatty acids, or terpenoids and of variations in oleoresin content of wood related to factors such as tree species, soil type, location, season, and climate. Our fundamental knowledge on the composition of wood extractives, tall oil, and oleoresin is still incomplete. Even in purified gum rosin, less than 85 percent of the chemical components have been identified. A number of modern analytical techniques might prove valuable for such fundamental purposes, including gas chromatography, mass spectroscopy, and nuclear magnetic resonance spectroscopy. Development of more adequate and efficient analytical procedures is a desirable first step for any fundamental research program on naval stores.

Fundamental studies of wood chemistry are needed to determine the chemical components present in wood and the variations in proportions of different compounds recoverable related to factors such as tree species, recovery methods, and other processing and pulping variables. Especially needed are analyses of the chemical structure and characteristics of rosins and turpentines of major western tree species which differ markedly in some respects from those of southern pines. Western

species such as ponderosa pine, lodgepole pine, and Douglas-fir offer large quantities of raw material and possible potential sources of new resin acids and turpentines. Extractives of spruce and true firs also merit attention. Only through research on the nature and possible uses of all softwood oleoresins can their potential value to industry be determined. Thus research aimed at characterization of the chemical components of wood could produce information of considerable value not only from the standpoint of fundamental knowledge, but also from the standpoint of industry.

Additional research may thus contribute to development of new uses of naval stores, to greater efficiency in production and processing with resulting lower costs, and, most important, to increased contributions to the national economy from this source of valuable chemical products.

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APPENDIX TABLES

TABLE 1.—*Number of gum producers, number of faces operated, and gum production in the United States, by size of operation, 1960*

Size of operation (faces)	Gum producers	Faces operated	Barrels [1] gum produced
	Number	*Thousands*	*Thousands*
1 to 999	438	276	6
1,000 to 4,999	2, 349	5, 413	113
5,000 to 9,999	588	3, 850	80
10,000 to 49,999	460	9, 179	191
50,000+	117	11, 108	232
Total	3, 952	29, 826	622

[1] 435 pounds net.

Source: Forest Service and Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.

TABLE 2.—*Number of gum producers, number of faces operated, and gum production in the United States, by State, 1960*

State	Gum producers	Faces operated	Barrels [1] gum produced
	Number	*Thousands*	*Thousands*
Georgia	3, 511	24, 393	509
Flordia	199	3, 416	71
Alabama	154	1, 209	25
Mississippi	84	761	16
Louisiana	3	45	1
South Carolina	1	2	(2)
Total	3, 952	29, 826	622

[1] 435 pounds net.
[2] Less than 500 barrels.

Source: Forest Service and Agriculture Stabilization and Conservation Service, U.S. Department of Agriculture.

TABLE 3.—*Gum naval stores processing plants in the United States, 1961*

Plant No.	Plant name	Plant location
1	Stallworth Pine Products Co.	Mobile, Ala.
2	Taylor-Lowenstein & Co	Do.
3	Nelio Chemicals, Inc	Jacksonville, Fla.
4	Newton Company of Florida, The.	Lake City, Fla.
5	Filtered Rosin Products Co	Baxley, Ga.
6	do	Douglas, Ga.
7	Nelio Chemicals, Inc	Fitzgerald, Ga.
8	do	Savannah, Ga.
9	do	Valdosta, Ga.
10	Langdale Co., The	Do.
11	Shelton Naval Stores Processing Co.	Do.
12	Peninsular-Lurton Co., The	Helena, Ga.
13	do	Homerville, Ga.
14	Standard Processing Co	Swainsboro, Ga.
15	Nelio Chemicals, Inc	Tifton, Ga.
16	Turpentine Farmers Corp	Waycross, Ga.
17	Varn & Co., K. S	Hoboken, Ga.
18	Vidalia Gum Turpentine Co	Vidalia, Ga.
19	Newton Naval Stores Co., Inc.	Wiggins, Miss.
20	Heyden-Newport Chemical Corp.	Oakdale, La.

Source: Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.

TABLE 4.—*Stump wood consumption and receipts at naval stores steam distillation plants, by State of stump wood origin, 1960* [1]

State of origin	Consumption	Receipts
	Thousand tons	*Thousand tons*
Florida	1, 025	1, 161
Mississippi	310	353
Alabama	287	319
Louisiana	249	282
Georgia	186	206
Texas and North and South Carolina	68	79
Total	2, 125	2, 400

[1] Stump wood includes small amounts of resinous logs.

Source: Forest Service, U.S. Department of Agriculture.

Table 5.—*Wood naval stores steam distillation plants in the United States, 1961*

Plant No.	Plant name	Plant location
1	Gulf Naval Stores Co	Andalusia, Ala.
2	do	Nocatee, Fla.
3	Crosby Chemicals, Inc	De Ridder, La.
4	Delta Pine Products Co	Covington, La.
5	Heyden-Newport Chemical Corp.	Oakdale, La.
6	do	Telogia, Fla.
7	do	Pensacola, Fla.
8	Dixie Pine Products Co	Hattiesburg, Miss.
9	Hercules Powder Co., Inc	Do.
10	do	Brunswick, Ga.
11	Southern Naval Stores Co	Columbia, Miss.
12	Reasor Chemical Co.[1]	Wilmington, N.C.
13	Continental Turpentine & Rosin Corp.	Shamrock, Fla.

[1] Under construction.

Source: Forest Service and Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.

Table 6.—*Tall oil fractionation plants in the United States, 1961* [1]

Plant No.	Plant name	Plant location
1	Arizona Chemical Co	Spring Hill, La.
2	do	Panama City, Fla.
3	Bell & Gossett Co	Morton Grove, Ill.
4	Crosby Chemicals, Inc	De Ridder, La.
5	Glidden Co., The	Port St. Joe, Fla.
6	Hercules Powder Co., Inc	Franklin, Va.
7	do	Savannah, Ga.
8	Monsanto-Emery Co	Nitro, W. Va.
9	Heyden-Newport Chemical Corp.	Oakdale, La.
10	do	Bay Minette, Ala.
11	Union Bag-Camp Paper Corp.	Savannah, Ga.
12	West Virginia Pulp & Paper Co.	Charleston, S.C.

[1] 1 additional Hercules Powder Co. plant under construction in Portland, Oreg., is not listed.

Note.—Hercules Powder Co. also has a plant in Burlington, Ontario.

Source: Pulp Chemicals Association.

TABLE 7.—*Production of rosin and turpentine in the United States, by source, 1900–1961*

Year beginning Apr. 1	Rosin [1]				Turpentine [2]			
	Total	Gum	S. D. Wood	Tall Oil [3]	Total	Gum	S. D. Wood [4]	Sulfate
	Thousand drums	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*
1900	1, 652	1, 652			620	620		
1901	1, 600	1, 600			600	600		
1902	1, 548	1, 548			581	581		
1903	1, 452	1, 452			545	545		
1904	1, 600	1, 600			600	600		
1905	1, 571	1, 571			590	590		
1906	1, 566	1, 566			588	588		
1907	1, 824	1, 824			585	585		
1908	2, 000	2, 000			750	750		
1909	1, 600	1, 600			600	600		
1910	1, 649	1, 638	11		617	615	2	
1911	1, 777	1, 758	19		664	660	4	
1912	1, 984	1, 905	79		730	715	15	
1913	1, 902	1, 799	103		695	675	20	
1914	1, 519	1, 492	27		566	560	6	
1915	1, 443	1, 412	31		537	530	7	
1916	1, 697	1, 626	71		626	610	16	
1917	1, 378	1, 250	128		502	474	28	
1918	997	909	88		359	340	19	
1919	1, 088	996	92		393	367	26	
1920	1, 358	1, 287	71		510	489	21	
1921	1, 365	1, 323	42		500	486	14	
1922	1, 542	1, 409	133		558	520	38	
1923	1, 695	1, 534	161		616	565	51	
1924	1, 610	1, 404	206		586	521	65	
1925	1, 516	1, 288	228		545	478	67	
1926	1, 680	1, 388	292		589	510	79	
1927	2, 093	1, 765	328		737	650	87	
1928	1, 867	1, 522	345		649	560	87	2
1929	2, 070	1, 696	374		724	625	96	3
1930	1, 972	1, 621	351		685	599	82	4
1931	1, 613	1, 357	256		564	500	57	7
1932	1, 659	1, 363	296		573	501	64	8
1933	1, 838	1, 431	407		622	526	87	9
1934	1, 783	1, 387	396		602	510	82	10
1935	1, 821	1, 361	460		603	497	94	12
1936	1, 866	1, 287	579		635	483	129	23
1937	2, 031	1, 388	643		700	518	143	39
1938	2, 077	1, 467	610		709	534	134	41
1939	1, 814	1, 054	760		605	383	166	56
1940	1, 717	939	778		566	344	168	54
1941	1, 708	791	917		549	285	199	65
1942	1, 656	869	787		560	322	154	84
1943	1, 463	784	679		508	288	129	91
1944	1, 318	692	626		471	245	122	104
1945	1, 452	694	758		488	244	134	110
1946	1, 720	752	968		570	270	173	127
1947	1, 991	828	1, 163		641	294	213	134
1948	2, 076	921	1, 155		659	324	210	125
1949	2, 028	925	1, 099	4	673	323	203	147
1950	2, 172	798	1, 339	35	709	272	243	194
1951	2, 084	716	1, 333	35	684	246	235	203
1952	1, 751	638	1, 083	30	565	217	178	170
1953	1, 780	532	1, 213	35	538	178	196	164
1954	1, 920	528	1, 342	50	618	176	210	232
1955	1, 947	453	1, 369	125	656	149	204	303
1956	1, 994	445	1, 324	225	645	144	196	305
1957	1, 865	400	1, 196	269	627	129	186	312
1958	1, 857	369	1, 183	305	608	120	173	315
1959	1, 916	334	1, 199	383	637	107	176	354
1960	2, 010	370	1, 220	420	605	119	163	323
1961	2, 051	474	1, 106	471	637	153	151	333

[1] 520-pound drums (net).
[2] 50-gallon barrels.
[3] Tall oil rosin data 1949–56 are estimates of Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.
[4] For 1919–56, includes destructively distilled turpentine.

Source: Statistical Reporting Service, U.S. Department of Agriculture.

TABLE 8.—*Commercial forest area in the longleaf-slash pine type, by State*

State	Area	State	Area
	Thousand acres		*Thousand acres*
North Carolina	863	Mississippi	2, 044
South Carolina	922	Louisiana	1, 967
Georgia	6, 246	Texas	482
Florida	9, 490		
Alabama	2, 996	Total	25, 010

Source: Forest Service, U.S. Department of Agriculture.

TABLE 9.—*Number of pine sawtimber trees in unworked stands suitable for gum production,*[1] *and faces worked in 1960–61 crop year, by State*

State	Pine sawtimber in unworked stands	Faces worked in 1960–61
	Thousand trees	*Thousand faces*
North Carolina	5, 435	0
South Carolina	20, 208	2
Georgia	37, 690	24, 393
Florida	28, 159	3, 416
Alabama	35, 289	1, 209
Mississippi	18, 423	761
Louisiana	9, 244	45
Texas	5, 397	0
Total	159, 845	29, 826

[1] Stands are considered suitable for gum production with a minimum of 15 longleaf or slash pine sawtimber trees (9 inches or larger d.b.h.) per acre in Alabama, Mississippi, Louisiana, and Texas, and 20 per acre in the Carolinas, Georgia, and Florida.

Source: Forest Service, U.S. Department of Agriculture.

TABLE 10.—*Commercial forest land ownership in the naval stores area, by State and ownership class* [1]

State	Public	Forest industry	Farm	Other private
	Percent	*Percent*	*Percent*	*Percent*
South Carolina	8	17	57	18
Georgia	6	19	60	15
Florida	14	34	18	34
Alabama	4	34	24	38
Mississippi	15	21	25	39
Louisiana	9	33	17	41
Texas	9	43	14	34
Naval stores area	10	29	32	29

[1] Includes only forest land in Survey units with significant acreages of longleaf-slash pine type.
Source: Forest Service, U.S. Department of Agriculture.

TABLE 11.—*Gum yield and pulpwood growth loss for one-faced slash pine, by size of tree*

Volume and value variables	D.b.h. of tree at start of gum production		
	10 inches	12 inches	14 inches
Total height — feet	66	72	74
Merchantable volume [1] — cords	0. 198	0. 318	0. 437
Expected annual volume increment of an unworked tree [1] — cords	. 0132	. 0149	. 0185
Annual volume deficit of a turpentined tree [1] — cords	. 0033	. 0037	. 0046
Annual gum yield per tree [2] — pounds	9. 9	13. 1	16. 3
Value of annual volume deficit [3] — dollars	. 023	. 026	. 032
Gross value of annual gum yields per tree [3] — dollars	. 68	. 90	1. 12

[1] Based on local volume tables for Olustee Experimental Forest, Baker County, Fla., using 90 as factor to convert cubic feet to cords.
[2] From Southeastern Forest Experiment Station Research Notes 138, by Bengtson and Schopmeyer, assuming a 30-percent crown ratio.
[3] Based on pulpwood at $7 per cord stumpage and gum at $30 per barrel (435 lbs.).

Source: Forest Service, U.S. Department of Agriculture

TABLE 12.—*Gum rosin, gum turpentine, and crude pine gum: Market and support prices and net volume of price support acquisitions or disposals, 1934–61*

[Market prices, f.o.b. plant. Price support rates in storage at plant]

Crop year beginning Apr. 1	Gum rosin			Gum turpentine			Crude pine gum average prices per std. barrel [1]		
	Average market price per 100 lbs. net	Support price per 100 lbs. net	Net change in CCC stocks	Average market price per gallon	Support price per gallon	Net change in CCC stocks	Market	Support: Unprocessed [2] equivalent	Support: Processed [3]
	Dollars	*Dollars*	*Thousand drums* [4]	*Dollars*	*Dollars*	*Thousand barrels* [5]	*Dollars*	*Dollars*	*Dollars*
1934	1.98	1.95	+150	0.396	0.420	+ 92	(6)	9.28	10.28
1935	1.97	1.95	+ 9	.376	.420	+ 55	(6)	9.28	10.28
1936	2.79	(7)	−126	.315	(7)	− 69	(6)	(7)	(7)
1937	3.20	(7)	− 33	.254	(7)	− 32	(6)	(7)	(7)
1938	2.18	2.34	+764	.166	.194	+145	(6)	7.79	9.04
1939	2.37	2.44	+188	.193	.197	− 91	(6)	8.11	9.36
1940	1.98	2.21	+207	.240	.217	− 8	7.36	7.64	8.89
1941	2.42	2.28	−540	.527	.287	− 92	11.70	8.59	9.84
1942	3.22	[8] 3.55	+160	.591	[8] .650	+154	14.60	15.99	17.49
1943	3.97	[8] 3.70	−589	.679	[8] .680	+ 70	17.70	16.76	18.26
1944	5.61	[8] 4.03	−183	.779	[8] .740	− 94	23.50	18.13	19.88
1945	6.50	3.89	− 2	.791	.720	−129	26.40	17.50	19.25
1946	7.43	4.05	− 6	.967	.744	− 1	30.80	18.23	19.98
1947	7.83	6.33	0	.627	.608	+ 53	28.20	23.32	25.32
1948	7.39	7.94	+407	.428	.483	+ 36	24.40	26.00	28.00
1949	6.47	6.73	+344	.384	.400	− 4	20.90	22.04	24.29
1950	6.31	4.77	−440	.551	.400	− 75	22.60	16.22	18.47
1951	8.73	7.37	+ 10	.763	.500	+ 1	30.50	24.97	27.28
1952	7.53	7.48	+283	.534	.500	+ 34	24.50	25.30	27.60
1953	7.72	7.49	+ 68	.516	.500	+ 14	24.60	25.03	27.62
1954	7.91	7.52	− 17	.519	.500	− 5	25.00	24.91	27.73
1955	8.45	7.43	−123	.556	.500	− 17	27.70	24.91	27.45
1956	8.37	7.49	− 26	.555	.500	− 26	26.60	24.80	27.66
1957	7.90	7.67	+ 11	.543	.510	+ 3	24.90	25.65	28.29
1958	8.33	7.97	− 15	.513	.500	− 2	24.50	26.10	29.04
1959	9.59	7.97	−503	.534	.500	− 7	28.00	25.74	28.98
1960	14.52	7.97	+ 1	.479	.500	+ 28	40.40	25.01	28.98
1961	11.95	9.69	+112	.247	.000	[9] + 2	33.10	24.95	28.98

[1] 435 pounds net.

[2] Computed from announced rates for processed turpentine and rosin. Price support has not been made on crude pine gum, as such, but rather on its storable primary processed derivatives.

[3] Crude gum support rates, processed basis, 1934 through 1950 computed from support rate for rosin and turpentine. Actual announced support rates 1951 through 1961.

[4] 517 pounds net.

[5] 50 gallons each.

[6] No prices available prior to 1940.

[7] No program.

[8] Represents purchase program rates. Loan rates were lower as follows: 1942 program: Rosin—$3.05; turpentine $0.55. 1943 program: Rosin—$3.50; turpentine $0.64. 1944 program: Rosin—$3.82; turpentine $0.70.

[9] Increase in turpentine stocks reflects processing of 1960 loan collateral initially stored as turpentine content in crude pine gum.

Source: Rosin and turpentine data: 1934–50 prices. Savannah Cotton and Naval Stores Exchange (discontinued in 1952); 1951–61 prices, USDA Naval Stores Market News Service. Price support rates and stocks, ASCS records. Crude pine gum prices, ASCS records.

Table 13.—*Distribution of old-growth longleaf and slash pine stump wood, by State and operability class, 1961*

State	Total stumps	Operable stumps[1]	Potential stumps[2]	Marginal and inaccessible stumps [3]
	Million tons	*Million tons*	*Million tons*	*Million tons*
North Carolina	2. 8	2. 4	0. 2	0. 2
South Carolina	5. 8	4. 3	1. 2	. 3
Georgia	22. 5	13. 8	7. 1	1. 6
Florida	24. 8	18. 4	5. 3	1. 1
Alabama	7. 5	4. 7	1. 9	. 9
Mississippi	3. 7	1. 0	1. 4	1. 3
Louisiana	3. 6	2. 6	. 9	. 1
Texas	2. 3	1. 0	1. 1	. 2
Total	73. 0	48. 2	19. 1	5. 7

[1] Stumps on areas of at least 25 contiguous acres with stumps, where topography is suitable for push-dozer operation and stumps can be removed without excessive damage to surrounding trees.

[2] Stumps on areas of at least 25 contiguous acres with stumps, where topography is suitable for push-dozer operation, but where stump removal would result in excessive damage to surrounding trees.

[3] Stumps on areas of less than 25 acres with stumps, or where topography is not suitable for push-dozer operation.

Source: Forest Service, U.S. Department of Agriculture.

Table 14.—*Distribution of ponderosa pine stump wood by State and operability class, 1960* [1]

State	Total stumps	Operable stumps[2]	Potential stumps,[3] cut in period—		Inaccessible due to forest density or erosion hazard
			1940–49	1950–59	
	Million tons	*Million tons*	*Million tons*	*Million tons*	*Million tons*
Washington [4]	2. 8	0. 7	0. 4	0. 5	1. 2
Oregon	13. 2	2. 7	2. 6	2. 6	5. 3
California	2. 0	. 6	. 3	. 3	. 8
Idaho [5]	1. 1	. 3	. 3	. 2	. 3
Montana	. 5	. 1	. 2	. 1	. 1
S. Dakota [6]	. 1	(7)	(7)	(7)	. 1
New Mexico	1. 7	. 6	. 4	. 4	. 3
Arizona	2. 5	. 7	. 5	. 9	. 4
Total	23. 9	5. 7	4. 7	5. 0	8. 5

[1] Tonnage on forest lands of all ownerships in areas considered most promising for stump procurement. (See fig. 26.) Stumps on other ponderosa pine areas are considered too scattered for this purpose. Tons are in terms of 20 year or older stumps—weights expected when stumps cut since 1940 reach age 20.

[2] Stumps cut prior to 1940 on which sapwood has rotted away, and which can be removed by bulldozers without excessive erosion or damage to surrounding trees.

[3] Stumps cut since 1940 on which sapwood has not rotted away, and which can be removed without excessive damage.

[4] Includes Bonner and Kootenai Counties of northern Idaho.

[5] Does not include Bonner and Kootenai Counties.

[6] Includes small area of Wyoming portion of Black Hills.

[7] Less than 0.1 million tons.

Source: Forest Service, U.S. Department of Agriculture.

TABLE 15.—*Annual domestic consumption of rosin, by industry, 1930–61*

[Drums of 520 pounds net]

Crop year beginning Apr. 1	Adhesives and plastics	Asphaltic products	Chemicals [1] and pharmaceuticals	Ester gums and synthetic resins	Foundries and foundry supplies	Insecticides and disinfectants	Linoleum and floor covering	Oils and greases	Paint, varnish, and lacquer	Paper and paper size	Printing ink	Railroads and shipyards	Rubber [1]	Shoe polish and shoe material	Soap	Other industries	Total
1930	21, 033	(2)	4, 197	-------	13, 919	------	23, 566	39, 862	154, 302	273, 062	10, 483	2, 469	-------	488	175, 174	8, 183	726, 738
1931	11, 122	(2)	3, 150	-------	5, 754	------	17, 397	23, 652	124, 474	239, 947	12, 131	59	-------	470	191, 895	4, 325	634, 376
1932	9, 247	(2)	2, 422	(3)	2, 930	------	12, 802	17, 519	96, 992	208, 800	8, 180	86	-------	232	209, 080	3, 436	571, 726
1933	9, 215	(2)	3, 111	(3)	1, 336	------	15, 624	24, 507	134, 912	256, 752	9, 342	31	-------	680	211, 338	6, 169	673, 017
1934	12, 892	(2)	2, 445	(3)	1, 908	------	12, 683	25, 466	140, 800	269, 600	9, 498	48	-------	904	226, 772	4, 852	707, 868
1935	21, 330	1, 446	2, 696	79, 006	8, 974	4, 286	19, 720	27, 476	117, 796	285, 714	12, 090	194	2, 035	7, 897	223, 000	8, 405	822, 065
1936	14, 402	1, 378	[4] 94, 723	81, 513	13, 488	3, 355	27, 820	25, 177	112, 034	328, 620	12, 749	167	2, 341	6, 997	237, 658	12, 544	974, 966
1937	14, 077	848	95, 397	89, 450	12, 182	3, 248	21, 986	19, 598	109, 518	272, 160	10, 210	232	2, 178	6, 541	218, 256	7, 036	882, 917
1938	9, 453	774	98, 671	86, 889	6, 360	3, 170	21, 850	19, 014	104, 222	254, 689	9, 251	1, 092	3, 135	8, 542	187, 942	7, 339	822, 393
1939	14, 374	861	130, 866	101, 629	8, 682	4, 100	29, 807	24, 861	126, 015	284, 498	10, 705	858	3, 922	7, 382	188, 011	7, 516	944, 087
1940	13, 434	6, 987	92, 806	101, 784	13, 392	2, 942	31, 418	24, 086	126, 238	262, 350	12, 402	2, 178	5, 242	6, 850	153, 013	7, 863	862, 985
1941	18, 455	3, 667	201, 001	216, 382	21, 264	4, 535	41, 209	32, 825	174, 198	355, 155	12, 923	5, 128	5, 661	9, 721	201, 094	7, 704	1, 310, 922
1942	13, 756	2, 411	207, 012	148, 263	9, 242	4, 563	32, 745	50, 938	131, 295	293, 617	15, 374	5, 458	5, 282	7, 607	190, 926	10, 377	1, 128, 866
1943	20, 046	2, 394	182, 004	146, 618	17, 476	5, 530	14, 687	29, 921	126, 340	382, 368	16, 618	11, 896	11, 383	9, 852	327, 058	8, 469	1, 312, 660
1944	30, 926	2, 473	265, 022	249, 252	14, 979	6, 032	19, 152	42, 372	133, 136	379, 383	12, 680	24, 855	22, 529	7, 235	324, 164	7, 176	1, 541, 366
1945	22, 656	1, 727	272, 303	250, 835	14, 364	5, 407	9, 602	26, 431	101, 240	274, 022	7, 435	17, 747	21, 234	5, 604	182, 683	5, 944	1, 219, 234
1946	20, 249	1, 622	344, 207	269, 406	13, 197	5, 170	20, 209	17, 493	113, 355	341, 772	9, 392	8, 827	26, 288	5, 362	152, 808	7, 588	1, 356, 945
1947	18, 095	1, 632	350, 103	257, 929	10, 004	3, 338	33, 532	13, 193	112, 890	347, 162	7, 530	4, 653	17, 741	5, 166	144, 090	5, 681	1, 332, 739
1948	19, 995	1, 232	345, 769	213, 096	5, 425	2, 490	41, 410	16, 449	110, 489	354, 941	6, 326	6, 499	15, 248	4, 144	94, 293	4, 513	1, 242, 319
1949	20, 096	885	329, 867	199, 862	3, 332	2, 314	30, 994	15, 683	93, 360	365, 740	5, 492	7, 980	9, 611	4, 382	74, 041	3, 778	1, 167, 417
1950	23, 714	894	[5] 402, 182	319, 878	2, 747	2, 409	38, 230	21, 457	102, 537	[5] 457, 922	6, 357	7, 042	16, 308	5, 011	92, 835	4, 222	1, 503, 745
1951	21, 783	593	370, 544	243, 565	3, 016	2, 070	31, 813	16, 649	80, 633	443, 083	5, 442	12, 484	24, 182	4, 871	57, 893	3, 271	1, 321, 892
1952	20, 036	853	317, 273	260, 638	1, 946	1, 966	30, 713	17, 021	78, 409	398, 052	6, 520	6, 663	34, 910	4, 128	46, 462	2, 890	1, 228, 480
1953	18, 275	1, 027	361, 935	262, 085	1, 354	1, 679	22, 040	14, 769	74, 398	399, 521	7, 730	3, 467	40, 458	2, 938	37, 479	2, 797	1, 251, 952
1954	17, 236	557	365, 912	247, 462	643	1, 377	14, 839	13, 024	67, 745	438, 615	8, 395	(6)	36, 061	2, 718	36, 909	4, 447	1, 255, 940
1955	23, 490	654	446, 822	239, 494	506	1, 448	12, 422	16, 402	64, 994	481, 283	8, 197	(6)	43, 154	2, 899	31, 695	8, 330	1, 381, 790
1956	18, 902	(6)	456, 483	225, 038	338	1, 401	(6)	13, 976	54, 090	419, 116	7, 758	(6)	56, 611	2, 114	16, 378	14, 745	1, 286, 950
1957	18, 059	(6)	442, 518	217, 746	134	1, 149	(6)	10, 762	58, 878	506, 817	8, 082	(6)	61, 564	1, 826	14, 407	10, 058	1, 352, 000
1958	14, 725	(6)	461, 856	218, 542	90	1, 195	(6)	8, 283	55, 480	541, 266	9, 233	(6)	67, 287	1, 553	11, 950	10, 730	1, 402, 190
1959	25, 365	(6)	563, 772	239, 961	148	1, 161	(6)	11, 259	57, 322	567, 716	10, 932	(6)	75, 365	1, 698	6, 275	12, 906	1, 573, 880
1960	(6)	(6)	545, 877	204, 073	(6)	(6)	(6)	(6)	46, 923	480, 101	(6)	(6)	76, 061	(6)	(6)	55, 765	1, 408, 800
1961	(6)	(6)	519, 846	220, 737	(6)	(6)	(6)	(6)	42, 357	507, 610	(6)	(6)	89, 479	(6)	(6)	63, 001	1, 443, 030

[1] Reported rosin consumption for rubber incomplete, and chemicals correspondingly larger.

[2] Included in adhesives and plastics.

[3] Included in paint, varnish, and lacquer.

[4] Beginning in 1936, includes rosin consumed in producers plants in the production of unclassified derived products.

[5] Prior to Oct. 1, 1950, all "B-wood resin" included in chemicals and pharmaceuticals; after that date "B-wood resin" used in making paper size is included in paper and paper size.

[6] Included in other industries (except that consumption by railroads which was primarily for maintenance was omitted).

Source: Statistical Reporting Service, U.S. Department of Agriculture.

TABLE 16.—*Annual domestic industrial consumption of turpentine, by industry, 1930–61*

[Barrels of 50 gallons]

Crop year beginning Apr. 1	Adhesives and plastics	Chemicals and pharmaceuticals	Foundries and foundry supplies	Insecticides and disinfectants	Oils and greases	Paint, varnish and lacquer	Printing ink	Railroads and shipyards	Rubber	Shoe polish and shoe material	Other industries	Total
1930	1, 405	1, 404	543	--------	436	81, 795	224	1, 310	------	10, 557	3, 230	100, 904
1931	847	825	126	--------	1, 084	68, 898	291	925	------	11, 101	2, 776	86, 873
1932	725	650	115	--------	586	45, 604	453	684	------	10, 986	1, 723	61, 526
1933	625	748	206	--------	201	51, 365	389	511	------	11, 516	1, 827	67, 388
1934	632	802	167	--------	191	51, 725	376	718	------	12, 678	2, 016	69, 305
1935	749	1, 359	326	600	225	66, 538	200	3, 875	1, 114	10, 234	2, 708	87, 928
1936	628	[1] 21, 583	1, 085	471	45	61, 528	212	5, 102	168	11, 267	3, 321	105, 410
1937	638	31, 275	759	526	45	55, 985	271	4, 421	138	10, 726	2, 815	107, 599
1938	526	22, 258	576	452	37	51, 292	489	3, 872	125	10, 711	2, 957	93, 295
1939	716	36, 026	659	354	24	53, 730	179	5, 071	149	12, 505	1, 849	111, 262
1940	365	40, 413	847	486	84	51, 437	230	6, 107	230	12, 453	1, 882	114, 534
1941	343	55, 625	1, 055	354	49	63, 849	237	7, 865	182	15, 470	1, 300	146, 329
1942	591	54, 890	1, 012	192	27	28, 326	201	8, 772	106	10, 322	924	105, 363
1943	467	[2] 137, 544	623	221	73	23, 690	207	9, 928	123	13, 806	697	187, 379
1944	352	143, 871	626	115	274	20, 745	307	9, 977	657	12, 620	652	190, 196
1945	264	124, 023	616	16	72	17, 828	216	8, 518	629	11, 336	572	164, 090
1946	228	105, 776	809	15	27	17, 059	200	6, 390	399	8, 652	504	140, 059
1947	166	114, 056	882	25	25	15, 048	154	4, 910	357	4, 143	843	140, 609
1948	179	79, 450	726	17	48	13, 584	160	5, 314	269	3, 507	703	103, 957
1949	149	91, 343	564	35	17	12, 141	156	4, 438	168	3, 039	392	112, 442
1950	160	130, 179	382	29	21	13, 293	145	4, 952	281	2, 798	596	152, 836
1951	121	207, 796	288	23	65	11, 351	169	7, 259	197	2, 214	291	229, 774
1952	[2] 108	164, 358	279	22	77	9, 777	105	5, 957	333	3, 020	278	184, 314
1953	76	187, 423	167	8	89	9, 262	108	5, 323	311	2, 526	249	205, 542
1954	63	219, 558	149	8	94	7, 977	140	[3]	119	1, 719	2, 533	232, 360
1955	78	320, 168	157	25	165	8, 919	85	[3]	147	1, 461	3, 855	335, 060
1956	48	317, 520	120	9	136	7, 617	81	[3]	267	1, 421	3, 671	330, 890
1957	85	378, 561	79	11	150	5, 840	72	[3]	462	1, 775	625	387, 660
1958	67	407, 486	69	10	176	5, 350	50	[3]	426	2, 115	151	415, 900
1959	61	406, 089	56	6	208	4, 713	65	[3]	355	2, 124	243	413, 920
1960	[3]	369, 545	[3]	[3]	[3]	4, 167	[3]	[3]	797	[3]	2, 261	376, 770
1961	[3]	362, 856	[3]	[3]	[3]	3, 624	[3]	[3]	680	[3]	2, 230	369, 390

[1] Beginning in 1936 includes turpentine consumed in producers plants in the production of unclassified derived products.

[2] Beginning in 1943 includes turpentine used in making beta-pinene for consumption in manufacturing synthetic resins.

[3] Included in other industries (except that consumption by railroads which was primarily for maintenance was omitted).

Source: Statistical Reporting Service, U.S. Department of Agriculture.

TABLE 17.—*Annual domestic consumption of turpentine, 1930–61*

[Thousand barrels of 50 gallons]

Crop year beginning Apr. 1	Reported industrial consumption	Primarily retail distribution	Total	Crop year beginning Apr. 1	Reported industrial consumption	Primarily retail distribution	Total
1930	101	272	373	1946	140	344	484
1931	87	206	293	1947	141	325	466
1932	62	299	361	1948	104	417	521
1933	67	270	337	1949	112	443	555
1934	69	278	347	1950	153	442	595
1935	88	264	352	1951	230	297	527
1936	105	283	388	1952	184	284	468
1937	108	335	443	1953	206	299	505
1938	93	327	420	1954	232	306	538
1939	111	366	477	1955	335	241	576
1940	115	347	462	1956	331	229	560
1941	146	358	504	1957	388	177	565
1942	105	291	396	1958	416	159	575
1943	187	285	472	1959	414	115	529
1944	190	324	514	1960	377	146	523
1945	164	349	513	1961	369	177	546

Source: Statistical Reporting Service, U.S. Department of Agriculture.

TABLE 18.—*U.S. consumption of rosin, by industry, 1960 with projections to 1970*

Industry	Year (crop year beginning Apr. 1)	
	1960 [1]	1970 [2]
	Drums [3]	*Drums* [3]
Adhesives and plastics	27, 257	30, 000
Chemicals and pharmaceuticals	545, 877	595, 000
Emulsion polymerization of synthetic rubber	[2] 125, 000–175, 000	130, 000–180, 000
Tackifying resins in latex, solvent rubber, and hot melt adhesives	[2] 100, 000–150, 000	160, 000–216, 000
Printing ink	[2] 50, 000– 75, 000	50, 000– 74, 000
Other (including various uses of B-wood resin)	[2] 150, 000–250, 000	160, 000–210, 000
Ester gums and synthetic resin	204, 073	185, 000
Protective coatings and printing ink	[2] 134, 000–182, 000	115, 000–155, 000
Chewing gum	[2] 25, 000– 35, 000	30, 000– 40, 000
Tackifying adhesives for natural rubber	[2] 15, 000– 25, 000	10, 000– 20, 000
Paint, varnish, and lacquer	46, 923	40, 000
Foundries and foundry supplies	38	20
Insecticides and disinfectants	993	500
Oils and greases	9, 823	7, 000
Paper and paper size	480, 101	655, 000
Printing ink	11, 053	11, 000
Rubber	76, 061	75, 000
Shoe polish and shoe material	1, 224	900
Soap	845	0
Other industries	4, 532	6, 580
Grand total	1, 408, 800	1, 606, 000

[1] Data from Statistical Reporting Service, U.S. Department of Agriculture.
[2] Estimated on the basis of personal interviews with industry representatives and projections of data reported in the literature.
[3] 520 pounds net.

TABLE 19.—*U.S. consumption of turpentine and turpentine fractions, by industry, 1960 with projections to 1970*

[Turpentine or turpentine equivalent]

Industry	Year (crop year beginning Apr. 1)		Industry	Year (crop year beginning Apr. 1)	
	1960 [1]	1970 [2]		1960 [1]	1970 [2]
	Barrels [3]	*Barrels* [3]		*Barrels* [3]	*Barrels* [3]
Chemicals and pharmaceuticals	369, 545	430, 000	Adhesives and plastics (including resins from whole turpentine)	55	60, 000
Alpha-pinene	[2] 215, 000	245, 000	Foundries and foundry supplies	52	0
Synthetic pine oil	[2] 100, 000	120, 000	Insecticides and disinfectants	6	0
Insecticides, lube oil additives, and other (including synthetic camphor and menthol)	[2] 115, 000	125, 000	Oils and greases	180	200
Beta-pinene resins	[2] 46, 000	60, 000	Paint, varnish, and lacquer	4, 167	1, 000
Terpene hydrocarbons such as dipentene (primarily rubber reclaiming)	[2] 30, 000	35, 000	Printing ink	32	0
Miscellaneous terpene chemicals	[2] 78, 545	90, 000	Rubber	797	600
			Shoe polish and shoe material	1, 726	100
			Other industries	210	100
			Subtotal, industrial use	376, 770	492, 000
			Primarily retail distribution	146, 000	100, 000
			Grand total	522, 770	592, 000

[1] Data from Statistical Reporting Service, U.S. Department of Agriculture.
[2] Estimated on the basis of personal interviews with industry representatives and data reported in the literature.
[3] 50 gallons.

TABLE 20.—*Production of rosin, turpentine, and crude tall oil by specified countries, calendar years (except where otherwise noted), 1934–38 and 1946–61*

ROSIN (thousand drums of 520 lb. net)

Country	1934–38 average		1946–50 average		1951–55 average		1956		1957		1958		1959		1960		1961 (preliminary)	
	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total
United States [1]	1,916	62.8	1,997	66.2	1,897	57.3	1,994	52.9	1,865	50.5	1,857	48.4	1,916	49.1	2,010	48.6	2,051	48.2
China [2]	24	.8	30	1.0	163	4.9	400	10.6	330	8.9	450	11.7	350	8.9	350	8.5	260	6.1
Finland	0	------	7	.2	9	.3	15	.4	7	.2	16	.4	24	.6	28	.7	30	.7
France [3]	302	9.9	218	7.3	229	6.9	163	4.3	190	5.1	171	4.4	184	4.7	175	4.2	187	4.4
Greece	78	2.6	32	1.1	68	2.0	99	2.6	103	2.8	95	2.5	92	2.3	111	2.7	132	3.1
India	22	.7	38	1.3	58	1.8	73	1.9	72	2.0	77	2.0	80	2.0	86	2.1	95	2.2
Indonesia	9	.3	(*)	------	8	.2	15	.4	16	.4	16	.4	20	.5	21	.5	21	.5
Mexico	80	2.6	94	3.2	107	3.3	110	3.0	121	3.3	140	3.6	159	4.1	168	4.1	190	4.5
Poland	58	1.9	30	1.0	61	1.8	77	2.0	77	2.1	75	1.9	80	2.0	85	2.0	90	2.1
Portugal	168	5.5	197	6.5	171	5.2	189	5.0	223	6.0	209	5.4	226	5.8	259	6.3	320	7.5
Spain	113	3.7	130	4.3	123	3.7	107	2.8	131	3.5	134	3.5	142	3.6	172	4.2	170	4.0
Sweden	0	------	12	.3	20	.6	19	.5	22	.6	21	.5	22	.6	27	.7	30	.7
Turkey	0	------	(*)	------	(*)	------	1	------	5	.1	6	.2	10	.3	8	.2	11	.3
U.S.S.R. [2]	233	7.6	164	5.4	332	10.0	441	11.7	460	12.5	500	13.0	530	13.5	550	13.3	580	13.6
Other [4]	50	1.6	67	2.2	67	2.0	70	1.9	70	2.0	80	2.1	80	2.0	80	1.9	90	2.1
Total	3,053	100.0	3,016	100.0	3,313	100.0	3,773	100.0	3,692	100.0	3,847	100.0	3,915	100.0	4,130	100.0	4,257	100.0

TURPENTINE (thousand barrels of 50 gallons)

Country	1934–38 average		1946–50 average		1951–55 average		1956		1957		1958		1959		1960		1961 (preliminary)	
	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total
United States [1]	650	56.2	650	59.7	612	50.9	645	48.1	627	45.9	608	44.1	637	45.2	605	42.3	637	42.7
China [2]	10	.9	12	1.1	61	5.1	150	11.2	137	10.0	160	11.7	125	8.9	125	8.7	93	6.2
Finland	22	1.9	21	2.0	26	2.2	36	2.7	38	2.8	41	3.0	40	2.8	44	3.1	46	3.1
France [3]	121	10.4	85	7.8	90	7.5	64	4.8	75	5.5	67	4.9	72	5.1	68	4.7	73	4.9
Greece	30	2.6	12	1.1	26	2.2	35	2.6	40	2.9	37	2.7	36	2.6	42	2.9	50	3.4
India	8	.7	12	1.1	18	1.5	23	1.7	23	1.7	24	1.7	25	1.8	29	2.0	32	2.1
Indonesia	4	.3	(*)	------	3	.2	6	.4	6	.4	7	.5	8	.6	8	.6	8	.5
Mexico	28	2.4	31	2.8	34	2.8	34	2.5	41	3.0	43	3.1	47	3.3	55	3.8	58	3.9
Poland	22	1.9	12	1.1	23	1.9	30	2.2	30	2.2	31	2.2	33	2.3	35	2.4	37	2.5
Portugal	62	5.4	71	6.6	61	5.1	64	4.8	74	5.4	69	5.0	76	5.4	84	5.9	107	7.2
Spain	44	3.8	54	4.9	52	4.3	44	3.3	54	4.0	55	4.0	56	4.0	70	4.9	67	4.5
Sweden	27	2.3	44	4.0	42	3.5	50	3.8	52	3.8	51	3.7	56	4.0	63	4.4	63	4.2
Turkey	0	------	(*)	------	(*)	------	(*)	------	2	.1	2	.1	4	.3	4	.3	6	.4
U.S.S.R. [2]	87	7.5	60	5.5	130	10.8	132	9.8	141	10.3	153	11.1	165	11.7	170	11.9	180	12.1
Other [4]	43	3.7	25	2.3	25	2.0	27	2.1	27	2.0	30	2.2	30	2.0	30	2.1	34	2.3
Total	1,158	100.0	1,089	100.0	1,203	100.0	1,340	100.0	1,367	100.0	1,378	100.0	1,410	100.0	1,432	100.0	1,491	100.0

CRUDE TALL OIL (thousand short tons)

United States [1]	19	30.2	128	74.4	199	77.7	293	80.5	272	77.1	329	80.6	407	82.4	386	79.5	417	79.3
Finland	15	23.8	14	8.1	17	6.6	25	6.9	29	8.2	27	6.6	32	6.5	37	7.6	41	7.8
Japan	(*)	------	(*)	------	1	.4	2	.5	3	.8	5	1.2	6	1.2	6	1.2	6	1.1
Norway	1	1.6	1	.6	2	.8	2	.5	2	.6	3	.7	2	.4	3	.6	3	.6
Sweden	28	44.4	29	16.9	37	14.5	42	11.6	47	13.3	44	10.9	47	9.5	54	11.1	58	11.2
Other	(5)	------	(5)	------	(5)	------	(5)	------	(5)	------	(5)	------	(5)	------	(5)	------	(5)	------
Total	63	100.0	172	100.0	256	100.0	364	100.0	353	100.0	408	100.0	494	100.0	486	100.0	525	100.0

*Less than 500 barrels or drums.
[1] Crop years Apr. 1 through Mar. 31.
[2] Estimated.
[3] Crop years May 1 through Apr. 30.
[4] Includes output in Albania, Austria, Bulgaria, Honduras, Hungary, Japan, Norway, Pakistan, and Yugoslavia.
[5] No information available.

Source: Official trade statistics, foreign trade sources, U.S. Foreign Agricultural Service dispatches, Crop Reporting Board, and Bureau of the Census reports.

Table 21.—*Production of rosin and turpentine, by country, area, or bloc, 1961 and projected to 1970*

ROSIN (thousand drums [1])

Country, area or bloc	1961 [2]		1970 projection		
	Quantity	Percent of total	Quantity	Percent of total	Percent of increase over 1961
United States	2,051	48	2,140	41	4
Sino-Soviet bloc	958	23	1,400	27	46
Europe [3]	890	21	1,100	21	24
All other	358	8	560	11	56
Total	4,257	100	5,200	100	22

TURPENTINE (thousand barrels [4])

Country, area or bloc	1961 Quantity	1961 Percent of total	1970 Quantity	1970 Percent of total	Percent of increase over 1961
United States	637	43	866	43	36
Sino-Soviet bloc	320	21	470	24	47
Europe [3]	416	28	500	25	20
All other	118	8	165	8	40
Total	1,491	100	2,001	100	34

[1] 520 pounds net.
[2] Preliminary.
[3] Excluding Communist bloc.
[4] 50-gallon barrels.

Source: Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.

TABLE 22.—*Rosin, turpentine, and tall oil: Stocks in specified producing countries, Jan. 1, 1946–62*

Commodity and country	Annual average 1946–50	Annual average 1951–55	1956	1957	1958	1959	1960	1961	1962
ROSIN (thousand drums of 520 lb. net)									
United States:[1]									
Gum:									
Commercial	128	102	71	58	46	46	171	122	67
CCC	233	513	533	508	513	503	0	1	112
Total	361	615	604	566	559	549	171	123	179
Steam-distilled wood	116	138	113	94	71	65	55	145	158
Tall oil	1	5	15	30	39	27	25	44	123
Subtotal, United States	478	758	732	690	669	641	251	312	460
Foreign:									
France	30	50	50	51	42	43	21	35	64
Greece	7	15	30	10	6	29	19	32	28
Mexico [2]	19	26	13	13	30	21	29	27	30
Portugal	66	56	60	63.	56	59	28	38	215
Spain	[2] 100	[2] 99	50	40	51	10	8	15	57
Subtotal, foreign	222	246	203	177	185	162	105	147	394
Total	700	1,004	935	867	854	803	356	459	854
TURPENTINE (thousand barrels of 50 gallons)									
United States:[1]									
Gum:									
Commercial	41	34	35	34	29	21	29	19	30
CCC	45	36	37	11	14	12	4	33	35
Total	86	70	72	45	43	33	33	52	65
Steam-distilled wood [3]	80	115	100	110	[5] 69	[5] 62	[5] 100	[5] 98	[5] 85
Sulfate wood	(4)	(4)	(4)	(4)	[5] 39	[5] 39	[5] 62	[5] 61	[5] 85
Subtotal, United States	166	185	172	155	151	134	195	211	235
Foreign:									
France	25	22	26	10	6	5	5	16	15
Greece	4	7	5	4	7	14	4	3	15
Mexico [2]	5	6	4	3	3	8	10	19	20
Portugal	39	36	22	18	30	37	40	41	43
Spain	[2] 41	[2] 40	[2] 38	[2] 25	18	12	15	12	12
Subtotal, foreign	114	111	95	60	64	76	74	91	105
Total	280	296	267	215	215	210	269	302	340
TALL OIL (thousand short tons)									
United States:[1]									
Crude	19	28	43	48	50	62	67	45	48
Refined [6]	5	8	6	9	9	7	7	6	14
Total	24	36	49	57	59	69	74	51	62

[1] As of Mar. 31.
[2] Estimated.
[3] Includes destructively distilled wood turpentine and, through 1957, sulfate wood turpentine.
[4] Included with steam-distilled wood turpentine.
[5] Estimated allocation, as between steam-distilled and sulfate turpentine stocks of *total* wood turpentine stocks reported by Crop Reporting Board.
[6] Represents refined tall oil containing *less* than 90 percent free fatty acids.

Source: USDA Crop Reporting Board reports, Bureau of the Census reports, Foreign Service dispatches, foreign trade sources.

Table 23.—*World supply:* [1] *Rosin, turpentine, and tall oil, annual averages 1934–38, 1946–50, 1951–55, and annually 1956–62* [2]

Commodity and area	Annual averages			1956	1957	1958	1959	1960	1961 [3]	1962 [4]
	1934–38	1946–50	1951–55							
Rosin: [5]	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*	*Thousand drums*
United States	2, 610	2, 475	2, 655	2, 726	2, 555	2, 526	2, 557	2, 261	2, 363	2, 490
Foreign	1, 337	1, 241	1, 662	1, 982	2, 004	2, 175	2, 161	2, 225	2, 353	2, 467
Total	3, 947	3, 716	4, 317	4, 708	4, 559	4, 701	4, 718	4, 486	4, 716	4, 957
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States in relation to total	66	67	62	58	56	54	54	50	50	50
Turpentine: [6]	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*	*Thousand barrels*
United States	849	816	797	817	782	759	771	800	848	874
Foreign	623	553	702	790	800	834	849	901	945	913
Total	1, 472	1, 369	1, 499	1, 607	1, 582	1, 593	1, 620	1, 701	1, 793	1, 787
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States in relation to total	58	60	53	51	49	48	48	47	47	49
Tall oil:	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*	*Thousand short tons*
United States	19	152	235	342	329	388	476	460	468	522
Foreign	44	44	57	71	81	79	86	100	108	112
Total	63	196	292	413	410	467	562	560	576	634
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States in relation to total	30	78	80	83	80	83	85	82	81	82

[1] Comprises production and stocks in specified countries covered in tables 20 and 22 or in text.
[2] Calendar year for foreign countries, crop year for United States.
[3] Preliminary.
[4] Estimated.
[5] Drums, 520 pounds net.
[6] Barrels, 50-gallon.

Source: See tables 20 and 22.

Table 24.—*Rosin: U.S. exports by destinations, calendar years 1934–38 and 1946–61*

[Thousand drums of 520 lb. net]

Country or area of destination	Averages				1956	1957	1958	1959	1960	1961
	1934–38	1946–50	1951–55	1956–60						
Europe:										
Belgium-Luxembourg	11	18	18	11	16	13	9	8	9	5
Czechoslovakia	8	11	(*)	2	1	2	2	3	1	2
Denmark	7	6	2	3	2	2	2	4	4	3
Finland	11	8	6	6	6	7	6	6	3	3
West Germany	105	39	73	114	101	106	90	131	145	94
Italy	24	37	33	41	39	43	28	37	57	45
Netherlands	58	38	42	60	57	54	52	70	70	68
Norway	12	6	4	4	4	3	2	3	6	1
Sweden	34	12	7	12	13	17	7	13	11	15
Switzerland	(*)	8	10	9	9	11	8	7	8	6
U.S.S.R	0	13	0	0	0	0	0	0	0	0
United Kingdom	204	126	118	120	91	125	101	126	159	82
Other	10	6	4	4	5	4	3	4	5	2
Total	484	328	317	386	344	387	310	412	478	326
Other Eastern Hemisphere countries:										
Australia and New Zealand	23	31	32	35	32	38	31	39	35	24
Indonesia	35	16	18	2	8	2	0	0	0	9
Japan	81	10	32	69	33	41	53	85	131	90
Philippine Republic	4	5	5	5	4	5	5	5	4	7
Union of South Africa	4	11	14	6	7	6	5	6	6	7
Other	29	18	13	11	18	13	8	11	7	4
Total	176	91	114	128	102	105	102	146	183	141
Western Hemisphere:										
Argentina	50	9	2	3	8	2	2	1	3	6
Brazil	46	51	25	6	1	9	6	3	10	8
Canada	46	57	47	53	52	49	53	56	57	47
Chile	7	8	3	1	1	(*)	(*)	1	1	1
Colombia	10	17	16	11	13	17	9	8	8	6
Cuba	15	15	10	9	11	9	8	9	7	0
Peru	1	4	3	3	4	3	4	3	2	2
Uruguay	5	7	2	1	1	2	(*)	(*)	2	1
Venezuela	2	4	3	2	3	2	2	2	2	4
Other	5	6	8	7	8	9	7	8	4	4
Total	187	178	119	96	102	102	91	91	96	79
Grand total	847	597	550	610	548	594	503	649	757	546
Current trade blocs:										
EEC	198	132	167	228	214	218	181	248	283	214
EFTA	268	168	148	154	127	165	126	160	192	111
LAFTA [1]	124	102	59	27	31	37	22	18	28	28
Total	590	402	374	409	372	420	329	426	503	353
Relation to grand total (percent)										
Europe	57	55	57	63	63	65	62	63	63	60
Other Eastern Hemisphere countries	21	15	21	21	19	18	20	23	24	26
Western Hemisphere	22	30	22	16	18	17	18	14	13	14
Current trade blocs:										
EEC	23	22	30	37	39	37	36	38	37	39
EFTA	32	28	27	25	23	28	25	25	25	20
LAFTA [1]	15	17	11	5	6	6	4	3	4	5
Total	70	67	68	67	68	71	65	66	66	64

*Less than 500 drums.

[1] Includes small Central American bloc.

Source: World Trends in Supply, Distribution and Prices of Naval Stores, 1934–49, and supplements thereto; reports of Bureau of the Census, U.S. Department of Commerce.

TABLE 25.—*Turpentine: U.S. exports by destinations, calendar years 1934–38 and 1946–61*

[Thousand barrels of 50 gallons]

Country or area of destination	Averages				1956	1957	1958	1959	1960	1961
	1934–38	1946–50	1951–55	1956–60						
Europe:										
Belgium-Luxembourg	10	15	11	4	7	8	2	3	2	2
Denmark	3	1	(*)	(*)	1	(*)	(*)	(*)	(*)	(*)
France	(*)	(*)	(*)	4	3	4	3	4	4	5
West Germany	19	22	29	27	36	29	20	16	35	19
Ireland	(*)	5	3	2	3	2	2	3	2	1
Italy	6	16	14	11	19	15	8	4	6	7
Netherlands	24	4	2	1	2	1	1	1	2	9
Sweden	2	2	1	2	2	2	1	1	1	1
Switzerland	0	2	1	(*)	1	(*)	0	(*)	0	(*)
United Kingdom	117	9	2	2	2	3	2	1	4	4
Other	1	1	(*)	1	1	(*)	1	(*)	(*)	1
Total	182	77	63	54	77	64	40	33	56	49
Other Eastern Hemisphere countries:										
Australia and New Zealand	16	7	1	1	1	1	1	1	1	1
Union of South Africa	4	4	4	3	3	4	2	3	3	4
Other	4	3	1	1	2	1	1	1	1	2
Total	24	14	6	5	6	6	4	5	5	7
Western Hemisphere:										
Argentina	4	2	(*)	(*)	1	(*)	0	(*)	(*)	(*)
Brazil	2	5	4	1	(*)	1	1	1	1	1
Canada	23	29	27	21	23	23	21	18	18	14
Chile	2	2	(*)	(*)	0	(*)	(*)	(*)	(*)	1
Uruguay	(*)	1	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Other	3	3	4	3	3	5	3	3	2	4
Total	34	42	35	25	27	29	25	22	21	20
Grand total	240	133	104	84	110	99	69	60	82	76
Current trade blocs:										
EEC	59	57	56	47	67	57	34	28	49	42
EFTA	123	14	4	5	7	6	4	2	5	5
LAFTA [1]	10	11	6	3	2	4	2	3	2	4
Total	192	82	66	55	76	67	40	33	56	51
Relation to grand total (percent)										
Europe	76	58	60	64	70	65	58	55	68	65
Other Eastern Hemisphere countries	10	10	6	6	5	6	6	8	6	9
Western Hemisphere	14	32	34	30	25	29	36	37	26	26
Current trade blocs:										
EEC	25	43	54	56	61	58	49	47	60	55
EFTA	51	11	4	6	6	6	6	3	6	7
LAFTA [1]	4	8	5	3	2	4	3	5	2	5
Total	80	62	63	65	69	68	58	55	68	67

*Less than 500 barrels.

[1] Includes small Central American bloc.

Source: World Trends in Supply, Distribution and Prices of Naval Stores, 1934–49, and supplements thereto; reports of Bureau of the Census, U.S. Department of Commerce.

TABLE 26.—*Tall oil: U.S. exports by destinations, calendar years 1946–61*

[Thousand short tons]

Country or area of destination	Averages 1946–50	Averages 1951–55	Averages 1956–60	1956	1957	1958	1959	1960	1961
Europe:									
Belgium-Luxembourg	0. 3	0. 4	0. 3	0. 3	0. 5	0. 2	0. 1	0. 6	1. 0
France	. 6	. 4	. 1	. 3	0	0	(*)	. 2	. 4
West Germany	3. 2	6. 5	3. 1	5. 0	5. 2	4. 2	. 1	. 7	. 2
Italy	1. 1	8. 0	7. 7	8. 0	12. 1	7. 0	3. 9	7. 6	5. 5
Netherlands	. 4	. 2	1. 0	. 8	. 6	. 8	. 4	2. 2	1. 0
Sweden	. 8	1. 0	(*)	0	(*)	(*)	. 1	. 1	. 1
United Kingdom	2. 8	2. 3	1. 6	1. 2	1. 7	1. 0	1. 3	2. 9	2. 2
Other	. 4	. 1	. 1	. 1	. 1	. 1	. 1	(*)	(*)
Total	9. 6	18. 9	13. 9	15. 7	20. 2	13. 3	6. 0	14. 3	10. 4
Other Eastern Hemisphere countries:									
Australia and New Zealand	(*)	. 1	. 3	. 5	. 1	. 3	. 3	. 5	. 4
Japan	(*)	. 2	1. 1	(*)	. 3	. 1	. 3	4. 6	. 9
Union of South Africa	. 3	. 3	. 2	. 4	. 2	. 2	. 1	. 1	. 1
Other	. 2	. 2	. 5	. 6	. 6	. 2	. 2	. 9	. 6
Total	. 5	. 8	2. 1	1. 5	1. 2	. 8	. 9	6. 1	2. 0
Western Hemisphere:									
Canada	1. 4	1. 7	2. 6	2. 2	2. 2	2. 3	2. 4	4. 0	2. 4
Colombia	(*)	. 4	. 5	. 6	. 6	. 5	. 2	. 7	1. 0
Cuba	. 6	. 2	. 1	0	0	. 1	. 1	. 1	0
Ecuador	. 1	. 6	. 6	. 9	. 6	. 6	. 3	. 4	. 1
Other	. 3	. 4	. 8	1. 3	1. 0	. 7	. 5	. 9	. 8
Total	2. 4	3. 3	4. 6	5. 0	4. 4	4. 2	3. 5	6. 1	4. 3
Grand total	12. 5	23. 0	20. 6	22. 2	25. 8	18. 3	10. 4	26. 5	16. 7
Current trade blocs:									
EEC	5. 6	15. 5	12. 3	14. 7	18. 5	12. 2	4. 6	11. 5	8. 3
EFTA	3. 9	3. 4	1. 7	1. 2	1. 8	1. 2	1. 4	3. 0	2. 3
LAFTA [1]	. 2	1. 2	1. 4	2. 1	1. 5	1. 2	. 7	1. 5	1. 5
Total	9. 7	20. 1	15. 4	18. 0	21. 8	14. 6	6. 7	16. 0	12. 1
Relation to grand total (percent)									
Europe	77	82	68	71	78	73	58	54	62
Other Eastern Hemisphere countries	4	4	10	7	5	4	9	23	12
Western Hemisphere	19	14	22	22	17	23	33	23	26
Current trade blocs:									
EEC	45	67	60	66	72	67	44	43	50
EFTA	31	15	8	5	7	7	13	11	14
LAFTA [1]	2	5	7	10	6	6	7	6	9
Total	78	87	75	81	85	80	64	60	73

* Less than 500 short tons.
[1] Includes small Central American bloc.
Source: World Trends in Supply, Distribution and Prices of Naval Stores, 1934–49, and supplements thereto; reports of Bureau of the Census, U.S. Department of Commerce.

Table 27.—*Rosin: Foreign trade, by country of destination, calendar years 1934–38 and 1946–60*

[Thousand drums of 520 lb. net]

Country or area of destination	Averages				1956	1957	1958	1959	1960
	1934–38	1946–50	1951–55	1956–60					
Europe:									
Austria	5	5	9	11	13	10	11	11	10
Belgium-Luxembourg	30	37	26	25	26	25	28	25	24
Czechoslovakia	39	20	22	30	17	32	33	34	35
Denmark	14	15	12	12	13	12	5	15	13
Finland	16	9	12	13	16	15	11	14	11
France	(*)	(*)	6	5	9	7	4	2	2
West Germany	278	73	129	200	168	176	170	224	261
Hungary	10	2	3	4	4	4	5	4	4
Italy	90	71	71	82	79	76	73	85	95
Netherlands	70	56	73	103	88	89	98	118	120
Norway	16	24	21	22	22	20	22	23	22
Poland	16	1	(*)	1	(*)	2	(*)	(*)	1
Rumania	17	3	6	5	2	13	4	2	4
Sweden	34	33	30	32	27	34	23	35	41
Switzerland	16	21	23	20	20	19	15	20	28
U.S.S.R.	(*)	22	(*)	63	(*)	119	126	45	28
United Kingdom	303	263	277	298	229	276	291	348	347
Yugoslavia	7	2	1	9	4	25	13	1	(*)
Other	5	5	5	6	7	4	6	5	10
Total	966	662	726	941	744	958	938	1,011	1,056
Other Eastern Hemisphere countries:									
Australia and New Zealand	33	32	33	37	33	38	34	42	39
Indonesia	37	16	25	12	22	17	6	6	6
Japan	96	11	53	102	80	78	88	117	148
Philippine Republic	4	5	5	5	4	5	5	6	5
Union of South Africa	4	12	17	8	7	8	9	8	7
Other	[1] 47	[2] 28	[3] 35	[3] 29	36	36	23	27	25
Total	221	104	168	193	182	182	165	206	230
Western Hemisphere:									
Argentina	51	26	11	16	19	12	14	13	20
Brazil	49	63	62	60	97	56	51	32	61
Chile	7	10	9	8	12	5	8	7	7
Colombia	11	19	17	11	13	17	9	9	9
Cuba	15	15	12	11	15	11	10	11	8
Uruguay	5	8	8	5	7	5	4	4	5
Other Latin America	9	16	14	14	16	14	13	13	14
Canada	46	57	47	53	52	49	53	56	57
Other	2	2	2	1	1	1	1	2	(*)
Total	195	216	182	179	232	170	163	147	181
Grand total	1,382	982	1,076	1,313	1,158	1,310	1,266	1,364	1,467
Current trade blocs:									
EEC	468	237	305	418	375	376	377	459	505
EFTA	404	370	384	408	340	386	377	465	472
LAFTA [4]	128	136	112	104	155	102	90	70	105
Total	1,000	743	801	930	870	864	844	994	1,082
Relation to grand total (percent)									
Europe	70	67	67	72	64	73	74	74	72
Other Eastern Hemisphere countries	16	11	16	15	16	14	13	15	16
Western Hemisphere	14	22	17	13	20	13	13	11	12
Current trade blocs:									
EEC	34	24	28	32	32	29	30	34	35
EFTA	29	38	36	31	30	29	30	34	32
LAFTA [4]	9	14	10	8	13	8	7	5	7
Total	72	76	74	71	75	66	67	73	74

*Less than 500 drums.

[1] Includes China (12); India, Pakistan, and Ceylon (11); Egypt (4); and United Kingdom and French African territories (10).

[2] Includes African territories (10); India, Pakistan, and Ceylon (4); Egypt (4); Turkey (3); and China (3).

[3] Mainly Ceylon, Egypt, Formosa, Israel, Korea, and Morocco.

[4] Includes minor imports of Central American trade bloc.

Source: U.S. Foreign Service reports; foreign official trade statistics; foreign private trade sources.

TABLE 28.—*Turpentine: Foreign trade, by country of destination, calendar years 1934–38 and 1946–60*

[Thousand barrels of 50 gallons]

Country or area of destination	Averages				1956	1957	1958	1959	1960
	1934–38	1946–50	1951–55	1956–60					
Europe:									
Belgium-Luxembourg	33	24	16	12	13	11	13	12	13
Czechoslovakia	11	15	8	6	6	6	5	7	8
Denmark	4	4	2	2	3	1	1	2	1
France	(*)	2	5	33	45	25	33	36	27
East Germany	([1])	2	10	12	14	12	17	9	10
West Germany	109	44	75	93	97	86	80	93	108
Hungary	6	3	4	5	5	6	4	4	5
Ireland	4	5	3	2	3	2	2	3	2
Italy	45	34	40	54	49	49	52	51	71
Netherlands	27	8	9	8	7	6	7	7	12
Sweden	4	3	2	3	2	3	2	3	3
Switzerland	23	23	15	19	27	26	17	13	12
United Kingdom	138	35	33	20	20	19	23	17	19
Other	10	5	7	5	3	4	4	1	11
Total	414	207	229	274	294	256	260	258	302
Other Eastern Hemisphere countries:									
Australia and New Zealand	16	9	5	3	4	3	2	2	2
Japan	1	1	1	1	1	1	(*)	1	2
Union of South Africa	4	4	4	4	4	4	4	4	4
Other	8	8	8	8	6	9	9	9	9
Total	29	22	18	16	15	17	15	16	17
Western Hemisphere countries:									
Argentina	4	2	2	1	1	1	(*)	1	1
Brazil	5	6	6	3	3	4	4	3	3
Other Latin America	6	5	5	5	5	6	4	5	4
Canada	23	30	27	21	23	23	21	18	19
United States	14	16	18	18	22	21	18	16	14
Total	52	59	[2] 57	48	54	55	47	43	41
Grand total	495	288	304	338	363	328	322	317	360
Current trade blocs:									
EEC	215	111	144	203	213	179	187	202	235
EFTA	172	68	54	45	55	51	45	35	37
LAFTA [3]	13	12	11	7	7	7	6	7	6
Total	400	191	209	255	275	237	238	244	278

Relation to grand total (percent)

	1934–38	1946–50	1951–55	1956–60	1956	1957	1958	1959	1960
Europe	84	72	75	81	81	78	81	81	84
Other Eastern Hemisphere countries	6	8	6	5	4	5	5	5	5
Western Hemisphere countries	10	20	19	14	15	17	14	14	11
Current trade blocs:									
EEC	43	38	47	60	59	55	58	64	65
EFTA	35	24	18	13	15	15	14	11	10
LAFTA [3]	3	4	4	2	2	2	2	2	2
Total	81	66	69	75	76	72	74	77	77

*Less than 500 barrels.

[1] Included with West Germany.

[2] Total of individual Western Hemisphere countries slightly exceeds total shown because of rounding of figures.

[3] Includes minor imports of Central American trade bloc.

Source: U.S. Foreign Service reports; foreign official trade statistics; foreign private trade sources.

TABLE 29.—*Rosin: Foreign trade, by country of origin, calendar years 1934–38 and 1946–61*

[Thousand Drums of 520 lb. net]

Period	Exporting country								
	United States	France	Greece	Mexico	Portugal	Spain	U.S.S.R.	Other	Total
1934–38	847	153	74	25	[1] 137	[2] 77	7	[3] 62	1, 382
1946–50	597	56	30	35	194	50	2	[3] 18	982
1951–55	550	80	60	51	163	39	54	[4] 79	1, 076
1956–60	610	44	97	75	215	51	41	[5] 180	1, 313
1946	409	34	19	26	111	54	0	[3] 30	683
1947	684	1	23	36	211	85	0	[3] 17	1, 057
1948	467	16	37	30	213	10	0	[3] 20	793
1949	588	110	33	36	208	40	2	10	1, 027
1950	839	120	37	49	227	59	5	14	1, 350
1951	659	32	46	53	239	47	35	[4] 59	1, 170
1952	374	51	48	31	93	6	51	[4] 63	717
1953	463	142	57	80	170	23	60	[4] 87	1, 082
1954	659	86	57	48	152	73	66	[4] 88	1, 229
1955	595	91	92	43	160	44	58	[5] 97	1, 180
1956	548	55	114	50	189	25	42	[5] 135	1, 158
1957	594	55	81	53	245	8	45	[5] 229	1, 310
1958	503	20	98	81	180	63	40	[5] 281	1, 266
1959	649	56	98	76	231	75	40	[5] 139	1, 364
1960	757	34	93	113	229	81	40	[5] 120	1, 467
1961	546	7	128	120	134	47	[6] 40	[6] 110	1, 132

[1] Represents average for 1937 and 1938 calendar years. Data for previous years not available.
[2] Because of Spanish civil war, data not available for years 1936–38. Consequently, for these 3 years import data from Germany, Italy, Belgium, Switzerland, and the United Kingdom were assumed as total Spanish exports.
[3] Mainly reexports.
[4] Mainly China and Poland.
[5] Mainly China.
[6] Estimated from importing country data.

Source: U.S. Department of Commerce, Bureau of the Census reports; U.S. Foreign Service reports; foreign official trade statistics.

Table 30.—*Turpentine: Foreign trade, by country of origin, calendar years 1934–38 and 1946–61*

[Thousand barrels of 50 gallons]

Period	Exporting country									
	United States	Finland	Greece	Mexico	Portugal	Spain	Sweden	U.S.S.R.	Other	Total
1934–38	240	[1] 11	25	15	[2] 58	[3] 45	13	41	47	495
1946–50	133	[1] 5	6	15	62	21	28	11	7	288
1951–55	104	3	13	20	45	10	30	49	30	304
1956–60	84	13	18	26	52	5	43	62	35	338
1946	98	[1] 6	1	17	59	14	21	*(1)	4	220
1947	104	[1] 6	8	15	55	18	19	*(1)	9	234
1948	95	[1] 5	6	16	54	4	30	[1] 7	8	225
1949	164	[1] 4	7	14	74	35	37	[1] 18	6	359
1950	202	2	9	15	69	35	31	28	8	399
1951	131	(*)	8	20	64	10	29	52	13	327
1952	80	3	16	16	32	(*)	23	30	30	230
1953	82	4	9	24	43	15	29	48	25	279
1954	114	3	8	19	45	14	36	55	43	337
1955	111	6	27	20	41	11	34	60	39	349
1956	110	7	20	26	59	13	37	61	30	363
1957	99	10	10	33	47	0	46	50	33	328
1958	69	16	15	18	42	0	44	66	52	322
1959	60	19	23	17	54	4	44	62	34	317
1960	82	12	20	37	60	7	46	69	27	360
1961	76	20	9	52	74	6	42	[1] 62	[1] 23	364

*Less than 500 barrels.

[1] Estimated from importing country data.

[2] Represent average for 1937 and 1938 calendar years. Data for previous years not available.

[3] Owing to Spanish civil war, data not available for years 1936–38. Consequently, for these three years import data from Germany, Italy, Belgium, Switzerland, and the United Kingdom were assumed as total Spanish exports.

Source: U.S. Department of Commerce, Bureau of the Census reports; U.S. Foreign Service reports; foreign official trade statistics.

TABLE 31.—*Rosin and turpentine: Consumption, actual and per capita, by specified countries and areas, 1934–38 and 1946–61* [1]

ROSIN (thousand drums of 520 lb. net)

Country or area	Averages 1934–38	Averages 1946–50	Averages 1951–55	Averages 1956–60	1956	1957	1958	1959	1960	Estimated 1961
United States	970	1, 343	1, 331	1, 400	1, 433	1, 341	1, 377	1, 526	1, 322	1, 363
Foreign:										
Western Europe [2]	1, 095	847	1, 037	1, 105	974	1, 082	1, 049	1, 193	1, 228	1, 122
Sino-Soviet bloc	415	280	494	867	799	808	914	888	925	918
Latin America	202	205	197	190	242	175	182	168	181	190
Japan	96	21	67	108	90	89	96	124	140	132
Australia [3]	33	32	33	37	33	38	34	42	39	28
Canada	46	57	47	53	52	49	53	56	57	48
Other	96	129	160	177	162	172	187	182	180	174
Total, foreign	1, 983	1, 571	2, 035	2, 537	2, 352	2, 413	2, 515	2, 653	2, 750	2, 612
Grand total	2, 953	2, 914	3, 366	3, 937	3, 785	3, 754	3, 892	4, 179	4, 072	3, 975
Modern trade blocs:										
EEC	-------	-------	-------	559	489	549	503	591	607	598
EFTA	-------	-------	-------	470	381	410	453	523	527	433
LAFTA [4]	-------	-------	-------	171	218	156	163	149	167	175
Total	-------	-------	-------	1, 200	1, 088	1, 115	1, 119	1, 263	1, 301	1, 206

ROSIN (pounds per capita)

Country or area	Averages 1934–38	Averages 1946–50	Averages 1951–55	Averages 1956–60	1956	1957	1958	1959	1960	Estimated 1961
United States	-------	4. 76	4. 33	4. 18	4. 43	4. 07	4. 11	4. 48	3. 80	3. 86
Foreign:										
Western Europe [2]	-------	1. 48	1. 74	1. 79	1. 60	1. 76	1. 70	1. 91	1. 95	1. 77
Sino-Soviet bloc	-------	. 19	. 30	. 47	. 45	. 45	. 50	. 47	. 48	. 47
Latin America	-------	. 69	. 59	. 50	. 67	. 48	. 48	. 44	. 46	. 47
Japan	-------	. 14	. 40	. 61	. 52	. 51	. 54	. 70	. 78	. 73
Australia [3]	-------	1. 73	1. 58	1. 59	1. 48	1. 66	1. 46	1. 76	1. 60	1. 13
Canada	-------	2. 29	1. 64	1. 62	1. 68	1. 54	1. 62	1. 67	1. 66	1. 37
Other	-------	. 07	. 09	. 09	. 09	. 09	. 10	. 09	. 09	. 08
Total, foreign	-------	. 37	. 44	. 50	. 49	. 49	. 50	. 52	. 52	. 49
Grand total	-------	. 64	. 69	. 73	. 73	. 71	. 72	. 76	. 73	. 69

See footnotes at end of table.

TABLE 31.—*Rosin and turpentine: Consumption, actual and per capita, by specified countries and areas, 1934–38 and 1946–61* [1]—Continued

TURPENTINE (thousand barrels of 50 gallons)

Country or area	Averages 1934–38	Averages 1946–50	Averages 1951–55	Averages 1956–60	1956	1957	1958	1959	1960	Estimated 1961
United States	390	524	523	550	560	565	575	529	521	546
Foreign:										
Western Europe [2]	518	377	393	461	470	455	437	444	501	526
Sino-Soviet bloc	118	97	192	270	275	266	268	262	281	280
Latin America	31	29	26	26	19	20	30	39	20	21
Canada	23	30	28	26	27	27	26	23	24	22
Other	44	31	35	45	26	53	44	52	52	66
Total, foreign	734	564	674	828	817	821	805	820	878	915
Grand total	1, 124	1, 088	1, 197	1, 378	1, 377	1, 386	1, 380	1, 349	1, 399	1, 461
Modern trade blocs:										
EEC	-------	-------	-------	295	308	285	271	297	315	322
EFTA	-------	-------	-------	112	114	106	104	96	117	131
LAFTA [4]	-------	-------	-------	24	17	16	28	37	18	19
Total	-------	-------	-------	431	439	407	403	430	450	472

TURPENTINE (gallons per capita)

Country or area	Averages 1934–38	Averages 1946–50	Averages 1951–55	Averages 1956–60	1956	1957	1958	1959	1960	Estimated 1961
United States	-------	0. 179	0. 164	0. 158	0. 166	0. 165	0. 165	0. 149	0. 144	0. 149
Foreign:										
Western Europe [2]	-------	. 063	. 064	. 072	. 074	. 071	. 068	. 068	. 077	. 080
Sino-Soviet bloc	-------	. 006	. 011	. 014	. 015	. 014	. 014	. 013	. 014	. 014
Latin America	-------	. 009	. 007	. 007	. 005	. 005	. 008	. 010	. 005	. 005
Canada	-------	. 116	. 094	. 076	. 084	. 081	. 076	. 066	. 067	. 060
Other	-------	. 002	. 002	. 002	. 001	. 002	. 002	. 002	. 002	. 003
Total, foreign	-------	. 013	. 014	. 016	. 016	. 016	. 015	. 015	. 016	. 016
Grand total	-------	. 023	. 024	. 025	. 026	. 025	. 025	. 024	. 024	. 025

[1] Calendar years except for U.S. consumption which is on a crop year basis (Apr. 1–Mar. 31).
[2] Includes all Europe except Soviet-bloc countries and Yugoslavia.
[3] Includes New Zealand.
[4] Including minor volume of Central American bloc.

Source: Computed from supply and foreign trade data; Information on United States reflects actual domestic disappearance as reported annually by USDA Crop Reporting Board. Foreign consumption computed from foreign production, change in foreign stocks in producing and leading consuming countries, and U.S. exports and imports.

TABLE 32.—*Rosin: Estimated foreign consumption, by industries, 1949 and 1959, specified countries and areas*

[Thousand drums of 520 lb. net]

Country or area and calendar year	Industrial use									
	Paper	Paint and varnish	Soap	Polish and wax	Linoleum and plastic	Rubber	Printing ink	"Chemicals"	Other	Total
Europe:										
France:										
1959	61. 5	15. 0	6. 0	3. 0	16. 5	4. 5	0	9. 0	34. 5	150. 0
1949	40. 5	16. 6	40. 5	0	10. 7	3. 6	0	7. 1	0	119. 0
West Germany:										
1959	101. 0	62. 8	9. 0	0	26. 9	4. 5	4. 5	11. 2	4. 5	224. 4
1949	39. 2	39. 2	12. 7	0	4. 9	0	0	2. 0	0	98. 0
Netherlands:										
1959	42. 4	27. 6	0	0	0	0	2. 1	33. 9	0	106. 0
1949	11. 3	21. 7	4. 9	0	0	0	2. 7	6. 0	7. 6	54. 2
Spain:										
1959	40. 6	5. 6	13. 6	0	0	0	0	8. 0	0	67. 8
1949	8. 3	31. 7	25. 1	8. 8	0	5. 0	0	6. 8	3. 7	89. 4
United Kingdom:										
1959	111. 0	115. 0	7. 0	7. 0	49. 0	11. 0	0	28. 0	19. 8	347. 8
1949	65. 0	80. 0	26. 0	3. 0	26. 0	0	0	26. 0	34. 0	260. 0
Other:[1]										
1959	388. 1	223. 5	54. 7	11. 3	95. 2	18. 9	5. 7	88. 6	67. 0	953. 0
1949	165. 3	163. 6	104. 1	10. 9	36. 1	6. 9	2. 3	41. 3	43. 6	574. 1
Total, Europe:										
1959	744. 6	449. 5	90. 3	21. 3	187. 6	38. 9	12. 3	178. 7	125. 8	1, 849. 0
1949	329. 6	352. 8	213. 3	22. 7	77. 7	15. 5	5. 0	89. 2	88. 9	1, 194. 7
Other Eastern Hemisphere countries:										
Australia:										
1959	12. 0	8. 9	0	2. 0	0	0	. 7	6. 0	9. 2	38. 8
1949	2. 0	7. 8	2. 6	1. 5	0	0	0	4. 3	1. 4	19. 6
India:										
1959	36. 7	17. 0	30. 1	0	0	0	0	0	0	83. 8
1949	8. 6	10. 8	23. 6	0	0	0	0	0	0	43. 0
Japan:										
1959	64. 5	22. 2	6. 7	2. 6	3. 1	2. 1	18. 1	1. 5	3. 1	123. 9
1949	16. 8	8. 8	9. 7	. 8	. 4	. 4	1. 3	1. 3	2. 5	42. 0
Other:[2]										
1959	90. 3	82. 4	91. 8	10. 8	0	0	3. 6	17. 9	36. 6	333. 4
1949	23. 2	36. 9	60. 1	5. 5	0	0	0	8. 2	2. 7	136. 6
Total, other Eastern Hemisphere countries:										
1959	203. 5	130. 5	128. 6	15. 4	3. 1	2. 1	22. 4	25. 4	48. 9	579. 9
1949	50. 6	64. 3	96. 0	7. 8	. 4	. 4	1. 3	13. 8	6. 6	241. 2

See footnotes at end of table.

TABLE 32.—*Rosin: Estimated foreign consumption, by industries, 1949 and 1959, specified countries and areas*—Continued

[Thousand drums of 520 lb. net]

Country or area and calendar year	Industrial use									
	Paper	Paint and varnish	Soap	Polish and wax	Linoleum and plastic	Rubber	Printing ink	"Chemicals"	Other	Total
Canada and Latin America:										
Canada:										
1959	20.9	11.3	.5	1.1	0	0	0	22.5	0	56.3
1949	16.4	9.3	11.7	4.6	0	0	0	4.7	0	46.7
Latin America:[3]										
1959	48.0	19.8	64.6	0	0	0	0	29.9	5.5	167.8
1949	32.9	18.9	124.7	4.7	0	0	0	17.3	12.9	211.4
Total, Canada and Latin America:										
1959	68.9	31.1	65.1	1.1	0	0	0	52.4	5.5	224.1
1949	49.3	28.2	136.4	9.3	0	0	0	22.0	12.9	258.1
Total foreign consumption:										
Drums:										
1959	1,017.0	611.1	284.0	37.8	190.7	41.0	34.7	256.5	180.2	2,653.0
1949	429.5	445.3	445.7	39.8	78.1	15.9	6.3	125.0	108.4	1,694.0
Percent:										
1959	38.3	23.0	10.7	1.4	7.2	1.6	1.3	9.7	6.8	100.0
1949	25.4	26.3	26.3	2.3	4.6	.9	.4	7.4	6.4	100.0

[1] *Distribution* based on (1) estimated reported consumption in Switzerland, Sweden, Norway, Finland, Portugal, Greece, Yugoslavia, Denmark, Belgium, and Poland, plus (2) estimate for remaining countries based on consumption in specified and above-listed countries, excluding Scandinavia. *Volume* represents *all* European countries other than France, West Germany, Netherlands, Spain, and the United Kingdom.

[2] *Distribution* based on consumption in Australia, New Zealand, India, Union of South Africa, and Pakistan. However, *volume* represents *all* non-European Eastern Hemisphere countries other than Japan, India, and Australia.

[3] *Distribution* based on consumption in Mexico, Brazil, and Chile. However, *volume* covers *all* Western Hemisphere other than United States and Canada.

Source: Private trade reports and U.S. Foreign Service dispatches.

TABLE 33.—*Estimated foreign consumption of turpentine, by end use, specified countries and areas, 1949 and 1959*

[Thousand barrels of 50 gallons]

Country or area and calendar year	End use: Paint and varnish [1]	Cleaning and polish	Chemicals and pharmaceuticals	Total
Europe:				
Belgium:				
1959	3.6	7.0	1.3	11.9
1949	12.0	12.0	6.0	30.0
France:				
1959	51.8	23.9	28.3	104.0
1949	55.2	12.0	24.8	92.0
West Germany:				
1959	23.3	23.3	46.5	93.1
1949	38.3	34.0	12.7	85.0
Spain:				
1959	41.6	3.5	2.8	47.9
1949	15.4	2.4	.9	18.7
Switzerland:				
1959	5.7	3.7	4.0	13.4
1949	11.7	7.0	2.1	20.8
Other: [2]				
1959	232.2	42.3	56.2	330.7
1949	160.2	46.8	46.5	253.5
Total, Europe:				
1959	358.2	103.7	139.1	601.0
1949	292.8	114.2	93.0	500.0
Other Eastern Hemisphere countries: [3]				
1959	90.3	50.7	16.0	157.0
1949	31.6	14.7	9.8	56.1
Canada and Latin America:				
Canada:				
1959	19.7	3.3	0	23.0
1949	18.5	6.2	6.2	30.9
Latin America: [4]				
1959	18.7	9.4	10.9	39.0
1949	22.5	3.2	2.3	28.0
Total, Canada and Latin America:				
1959	38.4	12.7	10.9	62.0
1949	41.0	9.4	8.5	58.9
Total foreign consumption:				
Barrels:				
1959	486.9	167.1	166.0	820.0
1949	365.4	138.3	111.3	615.0
Percent:				
1959	59.4	20.4	20.2	100.0
1949	59.4	22.5	18.1	100.0

[1] Includes retail sales.

[2] *Distribution* based on consumption in United Kingdom, Portugal, Norway, Netherlands, Greece, and Finland. However, *volume* covers *all* European countries other than Belgium, France, West Germany, Spain, and Switzerland.

[3] *Distribution* based on consumption in Japan, Australia, and South African Union. However, *volume* covers *all* estimated consumption in Africa, Asia, and the Pacific area.

[4] *Distribution* based on consumption in Mexico, Brazil, and Chile. However, *volume* covers *all* estimated consumption in Western Hemisphere other than United States and Canada.

TABLE 34.—*U.S. gum naval stores prices, actual and in terms of 1961 dollars; indexes of actual prices, BLS wholesale price index, and average annual U.S. rosin and turpentine stocks, crop years beginning Apr. 1, 1930–61*

Crop years	Actual prices			Prices in 1961 dollars			Index numbers (1947–49=100)				Average level of stocks	
	Rosin (per 100 lb.)	Turpentine (per gallon)	Crude pine gum (per barrel)	Rosin (per 100 lb.)	Turpentine (per gallon)	Crude pine gum (per barrel)	Actual prices: Rosin	Actual prices: Turpentine	Actual prices: Crude gum	Wholesale prices	Rosin	Turpentine
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*					*Thousand drums*	*Thousand barrels*
1930	2. 18	0. 333	-------	4. 82	0. 737	-------	30. 2	69. 4	-------	53. 8	580	124
1931	1. 69	. 341	-------	4. 40	. 888	-------	23. 4	71. 0	-------	45. 7	750	130
1932	1. 23	. 328	-------	3. 55	. 948	-------	17. 0	68. 3	-------	41. 2	753	139
1933	1. 69	. 367	-------	4. 47	. 971	-------	23. 4	76. 5	-------	44. 9	710	134
1934	1. 98	. 396	-------	4. 74	. 947	-------	27. 4	82. 5	-------	49. 7	763	162
1935	1. 97	. 376	-------	4. 50	. 858	-------	27. 2	78. 3	-------	52. 2	698	210
1936	2. 79	. 315	-------	6. 20	. 700	-------	38. 6	65. 6	-------	53. 6	572	226
1937	3. 20	. 254	-------	6. 93	. 550	-------	44. 2	52. 9	-------	55. 0	686	221
1938	2. 18	. 166	-------	5. 13	. 391	-------	30. 2	34. 6	-------	50. 5	1, 121	296
1939	2. 37	. 193	-------	5. 59	. 455	-------	32. 8	40. 2	-------	50. 5	1, 312	276
1940	1. 98	. 240	7. 36	4. 58	. 556	17. 04	27. 4	50. 0	30. 0	51. 4	1, 409	226
1941	2. 42	. 527	11. 73	4. 86	1. 058	23. 55	33. 5	109. 8	47. 9	59. 3	1, 315	179
1942	3. 22	. 591	14. 56	5. 89	1. 080	26. 62	44. 5	123. 1	59. 4	65. 1	1, 234	232
1943	3. 97	. 679	17. 66	7. 03	1. 202	31. 26	54. 9	141. 5	72. 1	67. 2	1, 075	301
1944	5. 61	. 779	23. 51	9. 84	1. 367	41. 24	77. 6	162. 3	95. 9	67. 8	626	259
1945	6. 50	. 791	26. 48	11. 19	1. 361	45. 58	89. 9	164. 8	108. 0	69. 2	418	161
1946	7. 43	. 967	30. 78	10. 48	1. 364	43. 41	102. 8	201. 5	125. 6	84. 4	353	93
1947	7. 83	. 627	28. 14	9. 43	. 755	33. 90	108. 3	130. 6	114. 8	98. 8	274	169
1948	7. 39	. 428	24. 41	8. 46	. 490	27. 93	102. 2	89. 2	99. 6	104. 0	510	219
1949	6. 47	. 384	20. 99	7. 83	. 465	25. 41	89. 5	80. 0	85. 6	98. 3	818	221
1950	6. 31	. 551	22. 45	6. 98	. 610	24. 83	87. 3	114. 8	91. 6	107. 6	780	161
1951	8. 73	. 763	30. 50	9. 12	. 797	31. 87	120. 7	159. 0	124. 4	113. 9	670	173
1952	7. 53	. 534	24. 50	8. 08	. 573	26. 29	104. 1	111. 2	100. 0	110. 9	872	221
1953	7. 72	. 516	24. 60	8. 33	. 557	26. 54	106. 8	107. 5	100. 4	110. 3	891	216
1954	7. 91	. 519	25. 00	8. 54	. 560	27. 00	109. 4	108. 1	102. 0	110. 2	863	185
1955	8. 45	. 556	27. 70	9. 05	. 595	29. 66	116. 9	115. 8	113. 0	111. 2	776	172
1956	8. 37	. 555	26. 60	8. 64	. 573	27. 45	115. 8	115. 6	108. 5	115. 4	720	166
1957	7. 90	. 543	24. 90	7. 96	. 547	25. 08	109. 3	113. 1	101. 6	118. 2	673	155
1958	8. 33	. 513	24. 50	8. 31	. 512	24. 45	115. 2	106. 9	100. 0	119. 3	663	139
1959	9. 59	. 534	28. 00	9. 56	. 532	27. 92	132. 6	111. 2	114. 2	119. 4	427	159
1960	14. 52	. 479	40. 40	14. 45	. 477	40. 20	200. 8	99. 8	164. 8	119. 6	237	209
1961	11. 95	. 247	33. 10	11. 95	. 247	33. 10	170. 8	51. 5	135. 0	119. 0	431	240

Price bases: Rosin—Dollars per 100 pounds net in drums f.o.b. production points. Turpentine—Dollars per gallon bulk f.o.b. production points. Crude pine gum—Dollars per standard barrel of 435 pounds net, delivered at processing plants.

Quantitative bases: Drums of rosin—520 pounds net. Barrels of turpentine—50 gallons each.

Source: Prices of gum rosin and gum turpentine—Savannah Cotton and Naval Stores Exchange (1930–1950), USDA Naval Stores Market News Service (1951–61). Prices of crude pine gum—ASCS records. Index of wholesale prices—U.S. Department of Labor (Bureau of Labor Statistics). Rosin and turpentine stocks—Average level computed from USDA Crop Reporting Board reports.

TABLE 35.—*Comparative average prices of U.S. rosin and turpentine, f.o.b. plants, 1946–61*

Crop year beginning Apr. 1	Rosin (per 100 lb. net in drums)			Turpentine (per gallon bulk)		
	Gum	Steam-distilled wood [1]	Tall oil [2]	Refined		Crude
				Gum	Steam distilled	Sulfate
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1946	7.43	6.49	----------	0.967	----------	0.304
1947	7.83	8.21	----------	.627	0.566	.283
1948	7.39	7.41	----------	.428	.410	.150
1949	6.47	6.47	----------	.384	.342	.143
1950	6.31	7.18	----------	.551	.555	.222
1951	8.73	8.62	----------	.763	.696	.350
1952	7.53	7.28	----------	.534	.471	.183
1953	7.72	7.47	----------	.516	.452	.142
1954	7.91	7.77	----------	.519	.459	.194
1955	8.45	8.38	6.52	.556	.500	.250
1956	8.37	8.27	7.41	.555	.500	.258
1957	7.90	7.94	7.75	.543	.503	.285
1958	8.33	8.20	7.76	.513	.525	.317
1959	9.59	9.58	8.63	.534	.520	.318
1960	14.52	13.28	12.93	.479	.471	.212
1961	11.95	11.98	11.02	.247	[3] .240	.141

[1] Simple averages, grades G through X.
[2] Simple averages WW grade.
[3] Estimated.

Source: Gum rosin and gum turpentine—Savannah Cotton and Naval Stores Exchange (1946–50); USDA Naval Stores Market News (1951–61). Steam-distilled wood rosin—Oil Paint and Drug Reporter; Naval Stores Review; New York Journal of Commerce. Steam-distilled wood turpentine—Naval Stores Review. Tall oil rosin—American Paint Journal; New York Journal of Commerce. Sulfate turpentine—From consumers.

Table 36.—*Average rosin prices, grade WW quoted by principal exporting countries, calendar years 1930–61*

[Equivalent dollars per 100 lb. net]

Calendar year	F.O.B. processing plants, U.S.—Gum	C.I.F. London, United Kingdom								
		United States		China	France	Greece	Mexico	Portugal	Spain	U.S.S.R.
		Gum	Wood							
1930	3.13	3.85	-----	-----	3.22	-----	-----	-----	-----	-----
1931	2.88	3.62	-----	-----	2.57	[1] 2.57	-----	-----	[1] 2.48	-----
1932	2.18	2.88	-----	-----	2.27	-----	-----	[1] 2.18	[1] 2.33	-----
1933	1.84	2.56	-----	-----	2.35	-----	-----	[1] 2.11	-----	-----
1934	2.23	2.98	-----	-----	[1] 2.74	-----	-----	[1] 2.61	[1] 2.71	-----
1935	2.51	3.15	-----	-----	[1] 2.83	-----	-----	[1] 2.50	[1] 2.91	-----
1936	2.79	3.40	-----	-----	2.96	-----	-----	[1] 2.55	-----	-----
1937	3.98	4.63	-----	-----	4.16	-----	-----	-----	-----	-----
1938	2.83	3.60	-----	-----	2.74	-----	-----	[1] 2.40	-----	-----
1939 [2]	2.79	3.54	-----	-----	2.97	-----	-----	2.39	-----	-----
1940–48 [3]	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1949 [4]	6.75	[1] 8.25	-----	-----	-----	-----	-----	[1] 8.88	[1] 8.72	-----
1950	6.67	[1] 9.00	-----	-----	-----	-----	-----	9.38	[1] 8.48	-----
1951	9.23	[1] 11.52	-----	-----	-----	[1] 10.46	-----	11.58	-----	[1] 10.54
1952	7.80	[1] 10.78	-----	-----	[1] 8.72	-----	-----	10.22	-----	[1] 9.20
1953	7.80	[1] 9.30	-----	-----	[1] 8.46	-----	-----	8.74	[1] 8.62	8.12
1954	7.98	9.25	8.99	-----	9.31	[1] 9.61	9.16	9.29	8.93	-----
1955	8.48	9.80	9.75	-----	9.44	[1] 9.24	-----	9.50	-----	[1] 9.19
1956	8.58	9.89	9.47	8.89	[1] 9.59	9.46	-----	9.40	-----	[1] 8.89
1957	8.30	9.73	9.40	8.57	9.28	8.70	[1] 8.97	8.86	-----	-----
1958	8.50	9.86	9.46	7.92	9.68	7.91	-----	8.98	8.50	-----
1959	9.49	10.87	10.64	[1] 8.56	10.22	9.69	[1] 9.50	9.92	-----	-----
1960	14.62	16.22	13.69	13.98	[1] 13.44	[1] 17.84	[1] 14.06	16.90	15.24	-----
1961	12.23	14.53	-----	[1] 11.51	[1] 13.50	12.44	[1] 13.05	14.02	13.32	[1] 11.40

[1] Based on quotations during half the calendar year or *less*.

[2] January through August.

[3] Prices were controlled by United Kingdom from September 1939 through April 1949. Estimated prices of stocks ex store were: September–December 1939, $6.31; 1940, $5.66; 1941, $6.18; 1942, $5.95; 1943, $7.13; 1944, $8.12; 1945, $8.12; 1946, $9.52; 1947 and 1948, not available.

[4] April through December.

Source: Oil, Colour and Trades Journal (United Kingdom), Naval Stores Review (United States), private trade organizations, USDA Naval Stores Market News Service, Savannah Cotton and Naval Stores Exchange.

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